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Exploring Wheelchair Service Delivery in a Dedicated Seating Department

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EXPLORING WHEELCHAIR SERVICE DELIVERY IN A DEDICATED SEATING DEPARTMENT

by

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This study is a series of three studies aimed at exploring wheelchair service delivery in a department of physical and occupational therapists dedicated to wheelchair seating. The three studies utilized a retrospective analysis to investigate the clinical documentation written by the practicing clinicians between 2007 and 2017. The first study aimed to describe the wheelchair and accessory recommendations made in the 11-year period, in relationship to age and gender. The majority of recommendations in the dedicated seating department were for complex wheelchairs. The results indicated the ratio between standard and complex power mobility devices and four complexities of cushions changed, moving toward lower ratios of complex product recommendations.

The second study compared equipment recommendations made in 2017 with the actual equipment delivered by the durable medical equipment company, and examined the length of time between recommendation and delivery. The results indicated that a significant amount of recommendations were altered before delivery. Predicting differences between recommendation and delivery were more likely to occur with manual wheelchair recommendations using gender, age, funding source (public or private), and wheelchair complexity (defined in six categories). Additionally, a significant interaction was found in the length of time between complex power mobility device recommendation and public funding sources.

The third study explored how often, and for what reasons, people sought expert therapists in wheelchair seating in an attempt to understand how dedicated seating departments support people with chronic wheelchair needs. Using a mixed-methods approach, the quantitative results indicated that support needs differed between diagnoses more than age groups. The qualitative results described needs for services, session activities, and visit outcomes, but also found that a team approach and follow-up were critical. This study supported previous descriptions of best practice in wheelchair seating.

Overall, these three studies have healthcare policy and clinical implications. Wheelchair quality was utilized as a measure in all three studies, relating to currently proposed legislation to separate complex wheelchair coding categories from other durable medical equipment. Future studies that focus on wheelchair service delivery and investigate the impact wheelchair use should incorporate wheelchair complexity. This study also has clinical implications, by documenting barriers experienced by wheelchair users and service providers in the service delivery process, and exploring ways to the support of potential and active wheelchair users. The need for follow-up services, in particular, was an important theme throughout this study.

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CHAPTER 1

INTRODUCTION

Population of Wheelchair Users

Consumers in the United States face many overt and covert obstacles when seeking a wheelchair to compensate for their ambulatory difficulties. LaPlante and Kaye (2010) used data from the U.S. Census Bureau's Survey of Income and Program Participation to estimate that in 2005, 3.3 million wheelchair users lived at home in the United States. However, these are subjective reports, and do not consider wheelchair users who have been unable to procure their own wheeled mobility. People with an ambulatory disability, or "serious difficulty walking or climbing stairs" (Kraus, 2017, p. 38) would be likely to need a mobility aid, such as a wheelchair. In the United States between 2008 and 2015, 6.4% to 6.9% of respondents on the American Community Survey (ACS) reported an ambulatory disability (Kraus, 2017). Using ACS percentages, U.S. Census numbers from 2010 indicate that 20.8 million people ages 5 years and older had an ambulatory disability. The estimated number of people with an ambulatory disability in 2010 is six times more than the number of wheelchair users that LaPlante and Kay (2010) reported.

The National Academies of Sciences, Engineering, and Medicine (2017) attribute difficulty estimating the population of wheelchair users to the multi-fragmented approach to getting a wheelchair in the United States. However, the need for wheelchair seating will persist, as wheelchair users are expected to quadruple by the year 2030 (Flagg, 2009). Thus, the demand exists for additional research methods and measures to examine wheelchair provision, as studies have demonstrated that assessing access to healthcare requires the analysis of current and past

data (Gavin, Frederiksen, Robbins, Pazol, & Moskosky, 2017; Jones et al., 2003; Quinn, Robinson, Forman, Kreon, & Rosland, 2017).

Service Delivery of Wheelchairs and Accessories

People may obtain wheelchairs through a variety of methods, including private means such as borrowing a used wheelchair or paying out of pocket, or through their health care insurance. People who pursue wheelchairs privately are not directly restricted by health insurance regulations. However, in order for health insurance to fund wheelchair seating equipment, it must be obtained through a durable medical equipment (DME) supplier. For less complex manual wheelchairs and power mobility devices, the person may go directly to their DME supplier with an order from their physician. More complex manual wheelchairs and power mobility devices require an evaluation from licensed/certified medical professional (LMCP). Policies refer to this health care professional being a physical or occupational therapist, but also allows for physicians or practitioners with specific training and experience in rehabilitation wheelchair equipment (CMS, 2017a, 2017b). Organizational, or internal factors, impact the wheelchair evaluation process in different health-care settings.

The 3-Legged Stool

Many complex factors impact wheelchair access, including those external to the organization. These factors include the federal, state, and private level processes that regulate the service delivery process. Before a physician writes an order for a wheelchair evaluation, procedural based policy practices enacted at the federal level set the precedence for wheelchair and accessory payment by public and private funding sources. Wheelchair seating equipment and accessories that are available for reimbursement through healthcare insurance are labeled with a Healthcare Common Procedure Coding System (or HCPCS) code by the HCPCS workgroup at

the Centers for Medicare and Medicaid (CMS). This process is important to manufacturers and DME suppliers as reimbursement for specific codes is set within the Medicare fee schedule (Stanley, 2015). If the reimbursement, or the Medicare fee schedule, is less than the wholesale price of the product, then DME suppliers may not be able to provide it to the consumer without losing revenue.

Equipment coding is just one leg of the often called, "3-legged stool" (Stanley, 2015, p. 74). Coverage guidelines and payment (or reimbursement) are the remaining two legs, and in combination with equipment coding these also affect what a person may receive in terms of DME. For example, coverage guidelines dictate that in order for health insurance to fund wheelchair seating equipment, it must be obtained through a DME supplier. Additionally, requests for manual wheelchairs coded K0005 and power mobility devices in the Group 2 category with a single power option or more require an accompanying evaluation from licensed/certified health care professional. Policies refer to this health care professional being a physical or occupational therapist, but also allow for physicians or practitioners with specific training and experience in rehabilitation wheelchair equipment (CMS, 2017a, 2017b).

Barriers to Wheelchair Fit and Use

While the 3-legged stool impacts the availability of wheelchair equipment, additional elements also must align for a person to be fit with an appropriate wheelchair. An appropriate wheelchair is necessary, as it will support a person's health and function (Brienza et al., 2018), and depending on an individual's anatomical impairments and/or functional limitations an appropriate wheelchair can vary widely from one person to the next. For example, ultralight manual wheelchairs reduce upper extremity strain (Rehabilitation and Engineering Society of North America [RESNA], 2012). Power options such as tilt, recline, and elevating legs assist in

realigning posture, improving vision, speech and alertness, helping to manage orthostatic hypotension, respiration, and bowel and bladder function, and redistributing and relieving pressure (RESNA, 2015). Seat elevators compensate for environmental challenges to aid a person's ability to transfer independently, communicate at eye level, and reach items (Arva, Schmeler, Lange, Lipka, & Rosen, 2009; Sabari, Shea, Chen, Laurenceau, & Leung, 2016). However, personal factors such as physical, cognitive, and psychosocial status and the person's funding source, funding source regulations, and the involvement of knowledgeable people to guide the evaluation and equipment trials, all contribute to the final product prescribed to the individual wheelchair user (Dicianno et al., 2018; Eggers et al., 2009; Greer et al., 2012).

Additionally, the knowledge and expertise of the wheelchair seating team may impact the person's recommended equipment. Equipment recommendations made in specialty clinics have been associated with higher quality manual wheelchairs (Myaskovsky et al., 2017). Conversely, the prescription of lower complexity wheelchair recommendations have associated with no therapist involvement in the evaluation (Sprigle & Taylor, 2017). However, in organizations that employ physical or occupational therapists who complete wheelchair evaluations, models of service delivery vary significantly. The physical or occupational therapist may complete one wheelchair evaluation every other month secondary to other job responsibilities, or work within a seating department with a sole focus on people's wheelchair seating needs and thus complete many wheelchair evaluations each week. Some organizations will only serve clients who use a single DME supplier, while others mandate that the patients choose their own DME supplier. These variations matter, as the expertise of suppliers and providers have been cited as reported facilitators in the service delivery process (Dicianno et al., 2018).

Supporting the Person and Their Wheelchair

Even after equipment selection, potential and active wheelchair users often experience difficulties. Additional barriers reported from survey results include long insurance approval processes, availability of funding, lengthy waits for authorization, ordering and delivery of the equipment, and limited maintenance support post-delivery (Dicianno et al., 2018). Greer et al. (2012) reported that "…little follow-up is typically done after delivery, and formal assessments of outcomes are rare." (p. 143). Limited research has shown that follow-up may be necessary, as lack of follow-up may impact active wheelchair users. Hansen, Tresse, and Gunnarsson (2004) documented the necessity of active check-ups completed by occupational therapists, finding that 99% of wheelchairs inspected at 3 months post-delivery required some sort of action or maintenance. This intervention was found to decrease accidents in the study population. In people with spinal cord injury, wheelchair repairs with adverse consequences have been associated with higher odds of rehospitalization and pressure injury, as well as increased pain and decreased self-perceived health (Hogaboom, Worobey, Houlihan, Heinemann, & Boninger, 2018).

Reimbursement policies for physical and occupational therapy services describe requirements for ongoing utilization of services, but do not accommodate for situations where the therapist must wait three to nine months (or longer) while waiting for equipment. For addressing equipment needs after delivery, as shown by Hansen et al. (2004), longer periods of time between treatment may be sufficient. In a consultative model of wheelchair service delivery, a department consisting of physical and occupational therapists primarily complete wheelchair evaluations, often in one or two sessions, but may also complete wheelchair use training with the person prior to wheelchair selection, facilitate trial chairs, and engage in the

setup, delivery, and training of the person's selected wheelchair at delivery. Additionally, people may seek out services for other purposes, such as pressure mapping their current cushion, or problem-solving equipment use, in between wheelchair requests. In this model of care, collaboration between the wheelchair seating therapists and the person, his or her family, caregivers, and healthcare professionals (for example, school-based physical, occupational, or speech therapists) knowledgeable about the person's daily life in their various settings, is emphasized. The utilization of expert wheelchair seating physical and occupational therapists in this manner has not been studied, but may contribute to better understanding of the various ways in which healthcare organizations and physical and occupational therapists may support wheelchair potential and active wheelchair users.

Previous Literature

In the wheelchair seating industry, studies regarding access to wheelchairs and effective service delivery models are lacking. Many of the published articles related to wheelchair provision have been informational, intended to educate other professionals or examine the complex service delivery for wheelchairs (DiSantostefano, 2012; Eggers et al., 2009; Greer, Brasure, & Wilt, 2012; Hostak, Edwards, & Sprigle, 2013; Kim, Kim, & Schmeler, 2012; Murphy, 2012; Pedersen, 2014; Sprigle & De l'aune, 2013; Stanley, 2015). Studies that have addressed wheelchair quality have been cross-sectional and typically focus on specific populations of adults, such as people with spinal cord injury, or those with Department of Veteran's Affairs funding (Groah, Ljungberg, Lichy, Oyster, & Boninger, 2014; Myaskovsky et al., 2017; Winkler et al., 2010; Worobey, Oyster, Nemunaitis, Cooper, & Boninger, 2012). One study examined a cross-sectional sample of wheelchair claims from a DME company and reported wheelchair user demographics and the complexity of delivered equipment (Sprigle &

Taylor, 2017). However, this tendency to examine wheelchair provision cross-sectionally or within a narrowly defined population limits our attempts to understand broader issues, such as identifying the specific barriers and quantifying their impact on skilled wheelchair seating clinics and DME companies.

Purpose

People who need wheelchairs, whether a first-time or long-term wheelchair user, need an appropriate wheelchair to support their health and function. A person's age, diagnosis, and physical, cognitive, and psychosocial context, are known factors that need consideration when being matched with an appropriate wheelchair and accessories (Brienza et al., 2018). However, current literature is often too limited, has small sample sizes, or to focused on specific populations to translate to clinical practice. This series of three studies aims to examine facilitators and barriers to clinical practice and access to wheelchair equipment in a dedicated seating department. The first study examines wheelchair recommendations made in an 11-year period in a clinical setting for people of all ages and diagnoses, to understand how the seating industry has been impacted by internal and external factors. These factors may provide a basis from which to explore larger potential equipment access barriers as well. The second study focuses on the service delivery process to analyze differences exist in therapist recommended equipment and DME delivered equipment. Additionally, it seeks to identify if factors such as diagnosis, funding source, or wheelchair complexity can predict if differences are more likely to occur. The third study will determine how often, and for what reasons, patients seek the services of expert therapists in wheelchair seating. This study will disclose the frequency and type of support needed for wheelchair users over an 11-year period, contributing to best practice methods in wheelchair seating.

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CHAPTER II

STUDY ONE

Introduction

Since the early 2000s, the Center for Medicaid and Medicare Services (CMS) has more closely regulated wheelchair expenditures in response to a nearly 8-fold increase in claims (under $150 million to over $1.1 billion) for power mobility devices (PMDs) between 1997 and 2003 (DHHS OIG, 2004; GAO, 2004). Coupled with large profit margins on PMDs, fraudulent activities by suppliers have accounted for this large increase in claims (DHHS OIG, 2004; Fahrenthold, 2014; GAO, 2004; Goodwin, Nguyen-Oghalai, Kuo, & Ottenbacher, 2007). Over the past 20 years, CMS has made many impactful changes regarding wheelchair procurement in the areas of coding, coverage, and payment (Stanley, 2015). Codes for wheelchairs and accessories have evolved into more general categories that contain ranges of equipment and are universally applied across the nation (Stanley, 2015). The current coding practices, governed by stakeholders from public and private health insurance companies, require data demonstrating national programmatic need to add codes for new technology (HPCPS, 2006; Stanley, 2015). Diagnoses are an important indicator for equipment coverage; however psychosocial, physical, or cognitive deficits that exceed the norm are not considered in decisions on funding DME such as wheelchairs. (Stanley, 2015). Lastly, the payment scale has been affected beyond coding and coverage changes. For example, CMS has bundled certain options and accessories with a base wheelchair without increasing payment to durable medical equipment suppliers (Stanley, 2015).

CMS changes have threatened access to appropriate wheelchairs for many users (Groah, Ljungberg, Lichy, Oyster, & Boninger, 2014; Packer, 2017; Pedersen, Harmon, & Kirschner, 2014). Current coding practices have resulted in the placement of equipment into an existing

generic code, for which the attached maximum reimbursement amount may not cover the cost of the equipment (Stanley, 2015). This has restricted access, as DME suppliers have been unable to provide certain pieces of equipment or they would assume a financial loss. Additionally, CMS audits on equipment claims have recovered substantial payments, often due to non-DME (physician or clinician) errors, or statements within documentation that may be open to interpretation (Komishock, 2013; Roche, 2017). Packer (2017) reports that these audits have threatened the viability of DME suppliers, stating "Between 2012 and 2013, there was a 30% drop of CRT providers and a 40% drop of CRT provider locations throughout the United States." (p. 3).

In particular, equipment that has emerged in the last 20 years may be at the greatest risk of reduced access due to the above-noted changes in federal policy; especially complex equipment incorporating advanced technology. The current coding, coverage, and payment system does not support access for equipment that serves a small, medically complex portion of the population. At this time, clinicians and DME suppliers are advocating for new legislation that would establish a new category of equipment separate from standard durable medical equipment (StdDME), called complex rehabilitation technology (CRT). The bill, H.R. 2408, defines CRT as products that are:

- Designed or configured to meet an individual's unique needs and capacities
- Primarily used to serve a medical or functional purpose
- Require certain services to ensure appropriate design, configuration, and use (Ensuring Access, 2019)

H.R. 2408 needs evidence to support the need for a complex category of equipment separate from standard durable medical equipment (StdDME). Many of the published articles related to wheelchair provision are commentaries, intended to educate other professionals or examine the complex service delivery for wheelchairs (DiSantostefano, 2012; Eggers et al.,

2009; Greer, Brasure, & Wilt, 2012; Kim, Kim, & Schmeler, 2012; Murphy, 2012; Pedersen, 2014; Sprigle & De l'aune, 2013; Stanley, 2015). Studies that have addressed wheelchair quality are cross-sectional and typically focus on specific populations of adults, such as people with spinal cord injury, or with Department of Veteran's Affairs funding (Groah et al., 2014; Myaskovsky et al., 2017; Winkler et al., 2010; Worobey, Oyster, Nemunaitis, Cooper, & Boninger, 2012). One study examined a cross-sectional sample of wheelchair claims from a DME company and reported wheelchair user demographics and the complexity of equipment provided (Sprigle & Taylor, 2017). This tendency to examine wheelchair provision cross-sectionally with a narrowly defined population limits our understanding of the broader issues within this area of rehabilitation.

In attempting to demonstrate the need for a CRT category, many gaps in the literature have been identified that need to be addressed. A few examples have been presented including examining the type of wheelchair equipment recommended by clinicians, and studies that include clinical populations that need wheelchairs (Myaskovsky et al., 2017; Sprigle & Taylor, 2017). The present study examined 2007-2017 documentation from a skilled team of occupational and physical therapists in order to describe wheelchair recommendations made in a clinical setting for people of all ages and diagnoses. This time frame was chosen as it represented a period of consistent electronic documentation. Changes in wheelchair recommendations and accessories, categorized by quality and customizability, over a substantial time period were analyzed to add to the existing evidence base, as well as to foster advances in future research, policy, and clinical practice.

This study addressed two main research questions. First, how have the demographics of people needing wheelchairs changed over an 11-year time period? Second, how has the type of equipment recommended changed over time?

Methods

A retrospective chart review of documentation from 2007 to 2017 from one Midwestern rehabilitation hospital's wheelchair seating department was conducted to address the research questions. The documentation reviewed were letters of medical necessity which detailed patient-specific recommendations for wheelchairs, cushions, and/or accessories. The wheelchair seating department existed as the largest part of an assistive technology department that focused on matching people with wheelchair seating, device access, electronic aids to daily living, and augmentative communication equipment. During the time period, the wheelchair seating department employed the full-time equivalent of four physical and occupational therapists whose sole job responsibilities consisted of completing wheelchair evaluations and accompanying documentation, configuring wheelchairs and equipment (often at delivery and intermittently between full wheelchair recommendations), and problem-solving wheelchair seating needs. Although some clinicians transitioned in and out of the department throughout the years, overall turnover was low and all clinicians went through rigorous training and extensive mentoring before working independently.

From 2007 to 2017, the wheelchair seating department served people of all ages and diagnoses with wheelchair seating needs after referral by a physician. The patients were primarily seen on an outpatient basis at the rehabilitation hospital, as well as through a mobile unit that traveled three to five times a week into community settings such as center-based schools, group homes, and day programs. The wheelchair seating department valued close

collaboration with patient-selected or health-insurance dictated DME companies, as well as a custom seating department that served complex seating needs.

Other clinicians in the organization also addressed wheelchair seating needs as a part of their caseload. One outpatient physical therapist maintained a caseload of patients with Medicare funding one afternoon a week, completing evaluations in conjunction with local DME personnel. Around 2011 and 2012, the availability for evaluations in that setting outgrew the need, and the caseload overflowed into the wheelchair seating department. In the spring of 2016, the wheelchair seating department assumed all outpatient wheelchair seating evaluations for the organization. Inpatients' wheelchair seating needs were primarily processed by their inpatient physical therapist in coordination with a DME provider until 2016, when the wheelchair seating therapists added inpatient spinal cord injury patients to their caseload.

This study was approved by the Western Michigan University and the rehabilitation hospital's HSIRB committees.

Sample

This study utilized a convenience sample of all documents (letters of medical necessity) for patients seen in the department between January 1, 2007 and December 31, 2017. Only the documents that included at least a wheelchair base and cushion were coded in this sample, as these minimum components indicated that the person required a full wheelchair evaluation. One reviewer recorded and coded the information. Intra-rater reliability was calculated after secondary review of 10% (n = 458) of the documents for all variables, and an interclass correlation coefficient (ICC) was calculated for specific variables.

Analysis

A descriptive analysis was conducted to demonstrate changes in demographics and recommended wheelchairs over the 11-year time period. Graphical results are presented to demonstrate changes over time. Demographic variables, gender and age, were explored categorically. Age categories of 0-18, 19-64, and 65+ were utilized, aligning the categories with common funding sources; people aged 0-18 are on Medicaid or their parent's insurance plans, people 19-64 are of working age and on their own commercial plan, and 65+ are more likely to be on Medicare. Manual wheelchairs (MWC) and PMDs were divided into two categories, standard durable medical (StdDME) and complex rehab technology (CRT), similar to Sprigle and Taylor (2017). Four groups of cushions were analyzed: 1) recommendations that did not specify a cushion (indicating a general use cushion or standard seating), 2) skin protection, positioning, or skin protection and positioning non-adjustable cushions, 3) skin protection, or skin protection and positioning adjustable cushions, and 4) custom (or not-coded) cushions. Categorical funding source was gathered for the year 2017 (due to the use of various billing systems over the 11 year time period and time constraints) and examined as a binary variable: Medicare and no Medicare. IBM SPSS Statistics Version 23 for Macintosh (2015) and a Z-score calculator (Z Score, n.d.) were utilized for analysis of this data to evaluate change in proportion over time.

Results

A high degree of reliability was found between initial and second data review. Intra-rater reliability, calculated from 10% (n = 458) of the total dataset, was 99.23% for all variables. An Intraclass Correlation Coefficient ($ICC_{3,1}$) (95% confidence interval [CI]) for individual variables

ranged from a low in diagnosis category .98 (.98 -.98), P<.001, to 1.00 (1.00-1.00), P<.001 for age (Table 1). Acceptable ICCs [95% CI] were found for all variables.

Demographic data were examined over the 11-year time period (Table 2). The top three diagnoses for the three age groups varied, with more people presenting with a Cerebral Palsy diagnosis in the young and middle-age groups (n = 594, 43.1% and n = 678, 29% respectively), and more people diagnosed with cerebral vascular accident (CVA) in the older age group (n = 59, 30.6%) (Table 3). The number of wheelchair recommendations rose from 295 to 658 (N = 4,252). In 2007, 69.2% (n = 204) MWCs were recommended and 30.8% (n = 91) PMDs were recommended; in 2017, 59.3% (n = 390) MWCs and 40.7% PMDs (n = 268) were recommended (Figure 1). When examining the number of wheelchair recommendations by age, all groups demonstrated an increase over time; however, numbers increased the most for people in the age group, 19-64, with 167 in 2007 to 364 in 2017 (Figure 2). To compare the age groups, ratios were examined (Figure 3). Recommendations for the middle-age group remained consistent over time (approximately 65%), decreasing for the younger age group 0-18 (31.5%, n = 93 in 2007 to 27.8%, n = 183 in 2017) and increasing for the older age group 65+ (11.9%, n = 35 in 2007 to 16.9%, n = 111 in 2017).

From 2007 to 2017, the percentage of people categorized by sex with wheelchair recommendations remained similar, with males accounting for approximately 55% of the population each year (Figure 4). In 2007, 58% of the population was male (n = 171), compared to 53.6% in 2017 (n = 353). In 2007, 42% of the population was female (n = 124), compared to 46.4% in 2017 (n = 305). The median age of people who had wheelchair recommendations increased from 33.2 years of age in 2007 to 39 years of age in 2017.

StdDME and CRT equipment categories for MWC and PMDs were examined to evaluate changes in recommendations over time. Due to count differences in the numbers of recommendations made per year, percentages were examined. The seating department recommended more CRT than StdDME MWCs for all 11 years. In 2007, 78.6% of recommendations were made for CRT MWCs, compared with 91.5% of recommendations in 2017 (Figure 5). The difference in recommended CRT MWCs between 2007 (158 out of 199) and 2017 (357 out of 383) was significant at the .05 level. StdDME and CRT PMDs recommended each year demonstrated more change; in 2007, 92.6% of recommendations were in the complex category, as compared to 60.4% in 2017 (Figure 6). The difference in recommended CRT PMDs between 2007 (84 out of 90) and 2017 (162 out of 267) was significant at the .05 level.

The complexity of cushions changed over the years, increasing in the number of recommendations most for the general, not specified (least complex) category. The custom (most complex) category increased the least, by only 19 recommendations (Figure 7). When examining ratios, cushions in 2007 ranged from non-adjustable (8.8%) to custom (34.2%), and in 2017 from custom (18.2%) to those not-specified (30.2%) (Figure 8).

Analyzing funding sources for recommendations made in 2017 shed light on the Medicare population. In 2017, 0% of people age 0-18 had Medicare as a funding source, 36.5% of the middle-age group (age 19-64) had Medicare as a funding source, and 78.4% of the older age group (over 65) had Medicare. When looking at funding source in relationship to complexities of recommended equipment, the majority of MWC recommendations (n = 291, 76%) were CRT for people without Medicare (Table 4). The most PMD recommendations (n = 89, 33%) were CRT for people without Medicare.

Four main points stand out from this data. Overall, more CRT equipment (*n* = 3,576, 84.1%) was recommended than StdDME. While the ratio of StdDME to CRT was quite stable for MWCs despite the increase in number of recommendations per year, the number of recommendations for StdDME PMDs increased over the time period. Looking closer at the 2014 to 2017 data for PMDs (when ratios began to change consistently), the number of StdDME PMD recommendations (*n* = 21, 15.7% in 2014; *n* = 105, 39.2% in 2017) increased more than the number of CRT PMD recommendations (*n* = 113, 84.3% in 2014; *n* = 162, 60.4% in 2017).

Second, many graphs including the amount of recommendations made per year (Figure 1), MWC and PMD ratios (Figures 5 and 6), and cushions (Figures 7 and 8), suggest disruptions around 2009 and 2010, and again around 2013 and 2014, with movement in a consistent direction until 2017. For example, in 2010 a decrease in the number of recommendations for people 0-18 years and 19-64 years of age occurred; from 2013 to 2017 the number of recommendations for all age groups increased. StdDME PMD recommendations rose in 2009 before declining again, and then demonstrated slow upward change until two large spikes in 2014-2015 and 2016-2017. Looking closer at the changes in StdDME and CRT PMDs from 2014 to 2017 revealed that 61.9% (*n* = 13) of StdDME PMD recommendations were for people 19-64yrs of age in 2014, compared to 55.2% (*n* = 58) in 2017 (Figure 9). The 65+ age group accounted for 33.3% (*n* = 7) of StdDME PMD recommendations in 2014, compared with 43.8% (*n* = 46) in 2017. People aged 0-18 accounted for 12.4% (*n* = 14) of CRT PMD recommendations in 2014, and 9.3% (*n* = 15) in 2017. In 2014, 74.3% (n = 84) of CRT PMD recommendations were for people aged 19-64, and 64.8% (*n* = 105) in 2017 (Figure 10). People over 65 accounted for 13.5% (*n* = 15) CRT PMD recommendations in 2014, and 25.9% (*n* = 42) in 2017. Third, some demographics, including sex and the ratio of StdDME to CRT MWC

recommendations, appeared to remain fairly constant over the 11-year time period. Sex ratios remained around 55% male from 2007 to 2017, and MWC recommendations remained around 85% CRT despite increasing numbers of MWC recommendations. Fourth, the growth in number of recommendations over the years revealed that the need for skilled wheelchair evaluations grew during the time frame studied, especially from 2013 to 2017.

Discussion

The fraudulent activity identified by CMS investigators began a nearly two-decade period of various changes that affected the coding, coverage, and payment practices for wheelchairs and accessories (Stanley, 2015). Investigators revealed that claims for PMDs within the StdDME category were accountable for the increase in expenditures (DHHS OIG, 2004). Policies and programs that were enacted to control abuse of the system appear to have affected the seating department investigated in this study. Recommendations for StdDME PMDs from 2014 to 2017 rose steadily from seven to 46 for people over 65 years of age. This may be a reflection of organizational changes that moved seating evaluations for patients with Medicare that were done one afternoon weekly by an outpatient physical therapist to the wheelchair seating department; however, the seating department did not assume these evaluations in full until 2016. More likely, the increase in StdDME PMD recommendations for people over the age of 65 were due to increased utilization of the wheelchair seating department's knowledgeable services. Clinicians within the community may have referred patients due to productivity pressures, rendering them unable to complete the complex, time-consuming paperwork, or to a lack of understanding of the changing coverage policies and requirements. DME providers may have referred patients to prevent financial loss in the event of an audit, preferring the wheelchair seating department's expert documentation to accompany wheelchair recommendations.

Examining StdDME and CRT equipment categories revealed that people who need more complex equipment are at risk of restricted access, as demonstrated within the cushion and PMD results. Before 2013, more custom and adjustable cushions were recommended. Around 2013, the percentage of recommendations for cushions start moving toward equal percentages per category (approximately 25% for each of the four cushion categories). It should be noted that access to the custom seating department remained consistent over this time period. The change in recommendations could be due to advancements in technology that increased the customizability of commercial cushions; however, that does not explain the transformative shift to recommending more non-coded cushions. These results support that cushions should be included in the CRT legislation; as many categories of cushions currently are (CRT Codes, 2017). Within the legislation, cushions may be considered independently, where a cushion always exists in the CRT category based on its own characteristics. However, considering the cushion dependently, within the context of the wheelchair user who is recommended or uses a CRT wheelchair base, may be enough to protect access to vulnerable users.

The PMD recommendations provide valuable information for H.R. 2408. First, stakeholders in wheelchair seating and advocates for H.R. 2408 should consider the overall greater numbers of CRT recommendations in the 0-18 and 19-64 age groups when anticipating the population impact of the legislation. Second, while recommendations for both StdDME and CRT PMDs increased over the time period, the StdDME category increased more, both in the 19-64 age group and people over 65. These results indicate that the growth in StdDME recommendations is not simply due to people in the over 65 age group who present with less medically complex diagnoses. Establishing a separate CRT category of equipment will protect

people with complex medical needs, ensuring that their unique needs are considered in the pursuit of equipment.

External Factors

External factors that may have affected the study data include national economic and health care changes. From December 2007 through June, 2009, the United States experienced an economic recession (NBER, 2012). The number of wheelchair recommendations, percentage of recommendations by sex, manual wheelchair, power wheelchair, and cushion recommendation line graphs displayed changes in this time period inconsistent with the rest of the years. Medicare programs to control costs were enacted in this time period. Around 2010, Michigan Medicaid implemented standardized documentation in the form of the MSA-1656. In 2011, CMS started the Capped Rental program that placed Group 1 and 2 power wheelchairs into a 13-month rental program (CMS, 2010). In 2013, the CMS program, Competitive Bidding, started in two zip codes in close proximity to the rehabilitation hospital. This change mandated that people living in active competitive bid zones use specific DME providers for their equipment. Interestingly, minimal changes occurred in the number and percentage of wheelchair recommendations for people age 65+ until 2015. In 2014, the Affordable Care Act (ACA) was implemented. Michigan adopted the Medicaid expansion at the onset of the ACA. While few changes occurred between 2010 and 2013 in the data, it appears that the onset of the ACA may have increased access to care for many people.

Internal Factors

Dedicated seating departments are difficult to maintain for various reasons. While a knowledgeable team may best meet patient needs, therapists dedicated to wheelchair seating often have less billable time than the other departments due to the amount of paperwork per

clinical recommendation, evaluations that last longer than other departments (which may not be seen as medically necessary by the payer source, and therefore may not be reimbursed), and the amount of physical space the department requires (due to the storage of demo equipment).

Leadership changes, renovations and new clinical space, establishing new relationships among various departments, and transitions in documentation requirements affected the seating department over this time period. Leadership changes to the hospital and department affected productivity and scheduling. Transitions of the assistive technology department to different "parent" departments resulted in established productivity requirements and increased the expectation of the number of patients scheduled per day. Increases in caseload were accommodated with additional physical space and collaboration with other departments, such as inpatient. However, scheduling during periods of transitions was disrupted at times, resulting in difficulty maintaining a productive caseload. While external influences on documentation requirements occurred as a result of policy changes and standardized documentation, transitions in electronic medical record systems internally required workflow modifications.

While external factors appear to impact the type of equipment recommended as well as access to care, internal factors appear to have contributed to the ability of the seating department to keep up with demand and need.

Relationship of Results to Literature

A study published by Sprigle and Taylor (2017) reported similar results to this present study. They found that 86% of a random sample of NuMotion claims for adults were CRT. In this study, in 2017 79.8% of wheelchairs recommended by the seating department for all ages were within a CRT category. The percentage of CRT equipment provided by the manufacturer (NuMotion) was not largely different than that recommended by the seating department

therapists in the present study. Furthermore, the data in this study indicated that more people without Medicare were recommended CRT wheelchairs, and that Medicare beneficiaries required more StdDME power mobility devices. They also reported that in the 2014 Medicare data, 84% of wheelchair expenditures by CMS were StdDME power wheelchairs and adult manual wheelchairs.

A few explanations may exist for the disparity between Medicare numbers and study data. Complex patients are more likely to require skilled wheelchair evaluations or complex equipment (or both), in which the seating department in this present study and NuMotion specialize. CRT equipment has been related with decreasing age and more complex diagnoses, supported by results in the present study (Sprigle & Taylor, 2017). In the present study, the most common diagnoses in the older adult group were different than the other age groups, indicating that patient case-mix may be a valid contributor. The increase in Medicare expenditures on StdDME may also be due to the lower requirements for StdDME provision than CRT, as requirements mandate for equipment in a CRT category must have a licensed/certified medical professional (such as a physical or occupational therapist) and a certified Assistive Technology Professional from the DME company involved in those evaluations (CMS, 2017a, 2017b).

Strengths and Limitations

Strengths of this study include the large sample size, inclusion of the total population of people with all ages and diagnosis, and the longitudinal, retrospective design. Secondly, the wheelchair recommendations were made by therapists. This should result in the most medically appropriate recommendations, but internal and external factors, especially policy and close collaboration with DME professionals in the evaluations, may have impacted what was

ultimately recommended. Additionally, the design of the seating clinic allowed for patient or health insurance choice of DME supplier, reducing procedural bias in this study.

Limitations included that one therapist reviewed and collected the data; however, 10% of the data underwent a secondary check and ICC per variable was calculated for reliability. Additionally, changes in EMR over the time period impacted the feasibility of gathering funding source information for this study. The addition of funding source for years 2007-2016 would have increased the generalizability and power of the results. Incorporating more settings in this study may have revealed different results, as it is possible that the patient population, organizational culture, therapist knowledge, clinical practices, and equipment preferences may be very different than in other settings.

Conclusion

The present study may stimulate many research directions. Studies of similar design may be conducted and differences between StdDME and CRT for manual and power wheelchairs may be calculated using difference in difference or propensity score methods. Future research may closely examine the effects of external factors on the periods of disruption in recommendation data, including policy changes and economic challenges. Results may reveal the source of the changes impacting CRT power wheelchair equipment and complex cushions. The impact of the person's funding source on recommendations and an exploration of the difference between therapist recommended and supplier delivered equipment, would each add to the existing evidence base to support access to appropriate equipment and a quality service delivery. Additionally, the differences in equipment recommended for Medicare beneficiaries when compared to the rest of the population should be examined. It should be validated that these differences are due to the aging population's needs, not a lack of professionals in the

industry who are able to provide CRT equipment. Other studies that support the necessity of CRT equipment, setup, and training for patients' overall function and well-being need to occur, to continue quality service provision to the vulnerable population.

The present study produced interesting results. First, that over the 11-year time period, the population of people needing wheelchair recommendations has changed. While more demand for wheelchair recommendations is seen in all age groups, the older age group demonstrated most need. Also, differences did occur in recommendations made for standard and complex equipment between 2007 and 2017, especially in power wheelchairs and cushions. Recommendations for CRT power wheelchairs and custom cushions were reduced in relationship to the other equipment over the 11 years, and clinicians and suppliers need to ensure that this is due to need, not restricted access.

Table 2.1
Intraclass Correlation Coefficient for Intrarater Reliability

Variable	ICC (95% CI)	F (*df1*,*df2*)	*p*
Gender	.99(.99 - .99)	91.58(457,457)	<.001
Years of Age	1.00(1.00 – 1.00)	7,198,613.14(457,457)	<.001
Diagnosis	.98(.98 - .98)	53.10(457,457)	<.001
MWC HCPCS	.99(.98 - .99)	67.72(317,317)	<.001
PMD Group	1.00(--)	--(139)	--
Cushion Type	.98(.98 - .99)	55.90(457,457)	<.001

Note. Two-way mixed, absolute agreement ICC model.

Table 2.2
Descriptive Results of Total Sample

Variable		*n*	%
Gender	Male	2,395	56.3
Age	0-4	370	8.7
	5-17	1007	23.7
	18-24	435	10.2
	25-34	460	10.8
	35-44	400	9.4
	45-64	1,042	24.5
	65 and over	538	12.7
Manual Wheelchair	StdDME	301	11.4
	CRT	2,292	87.0
Power Mobility Device	StdDME	314	19.5
	CRT	1,284	79.8
Cushions	Not specified, None	1,102	25.9
	Non-adjustable	860	20.2
	Adjustable	1,088	25.6
	Custom, Not coded	1,202	28.3

Note. StdDME manual wheelchairs include HCPCS codes E2017, E1038, K0001-K0004, K0006, and K0007. CRT manual wheelchairs include HCPCS codes E1231-E1234, E1161, E1129, E1235-E1238, E1120, K0005, and K0009. StdDME power mobility devices include power operated vehicles and scooters, Group 1 and Group 2. CRT power mobility devices include Group 2a and Groups 3-5. Cushion categories include those not-specified (no cushion mentioned, E2601-E2602), Non-adjustable (E2603-E2608), Adjustable (E2622-E2625), and Custom/Not coded (E2609, E2610).

Table 2.3
Top Five Diagnoses by Age Group

Diagnosis	*n*	%
Young (0-18 years)		
Cerebral Palsy	594	43.1
MD and SMA	143	10.4
Spina Bifida	122	8.9
Congenital	113	8.2
Brain Injury	59	4.3
Middle (19-64 years)		
Cerebral Palsy	678	29.0
SCI (quad)	267	11.4
SCI (para)	249	10.7
Brain Injury	207	8.9
Multiple Sclerosis	154	6.6
Older (over 65 years)		
CVA	59	11.0
Multiple Sclerosis	49	8.9
SCI (quad)	48	8.9
Osteoarthritis	47	8.7
Amputation	45	8.4
All age groups		
Cerebral Palsy	1300	30.6
SCI (quad)	325	7.6
SCI (para)	302	7.1
Brain Injury	282	6.6
MD/SMA	236	5.6

Table 2.4
2017 PMD and MWC StdDME and CRT Without and with Medicare Funding

	MWC		PWC	
Variable	*n*	% MWC	*n*	% PWC
Without Medicare				
StdDME	18	4.7	32	12.0
CRT	291	76.0	89	33
With Medicare				
StdDME	8	2.1	73	27.3
CRT	66	17.2	73	27.3

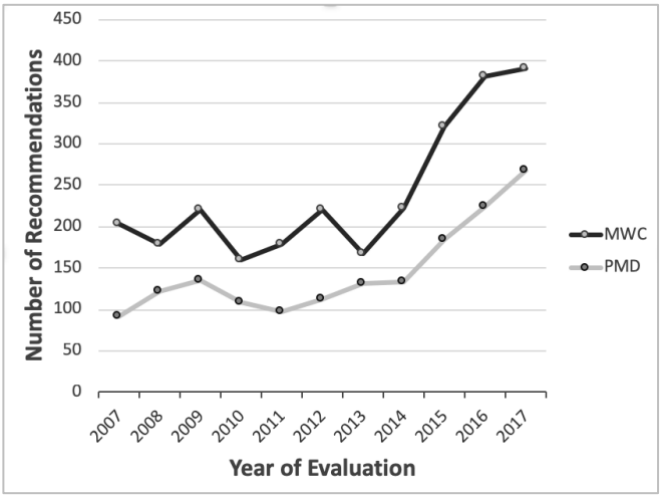

Figure 2.1. Number of MWC and PMD Recommendations

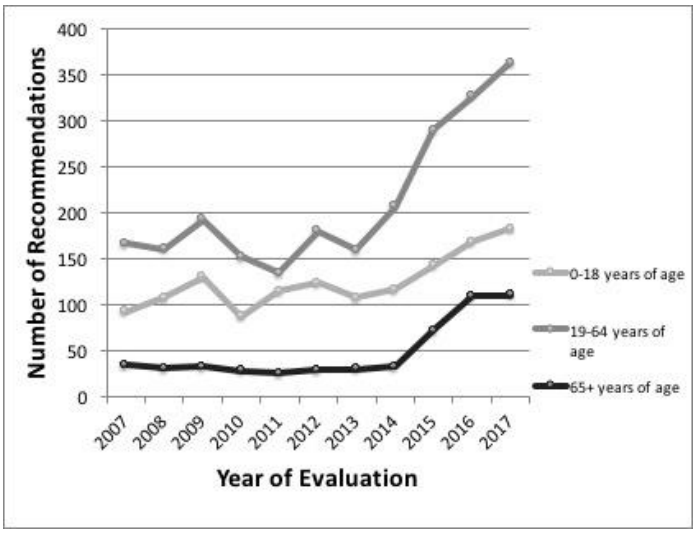

Figure 2.2. Number of Recommendations by Age

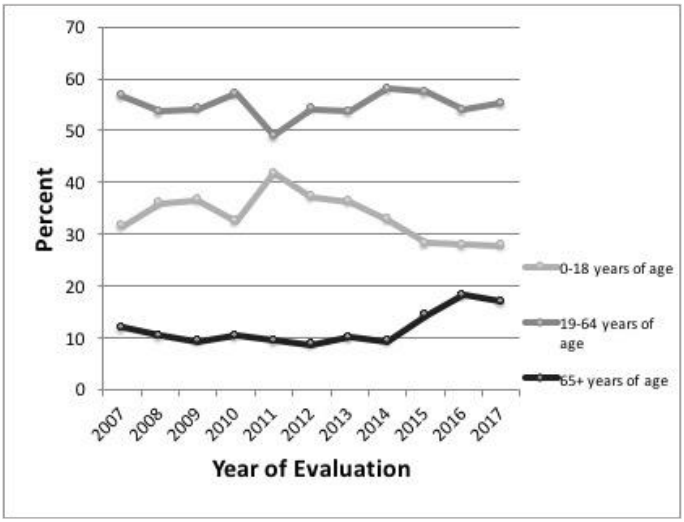

Figure 2.3. Ratio of Recommendations by Age per Year

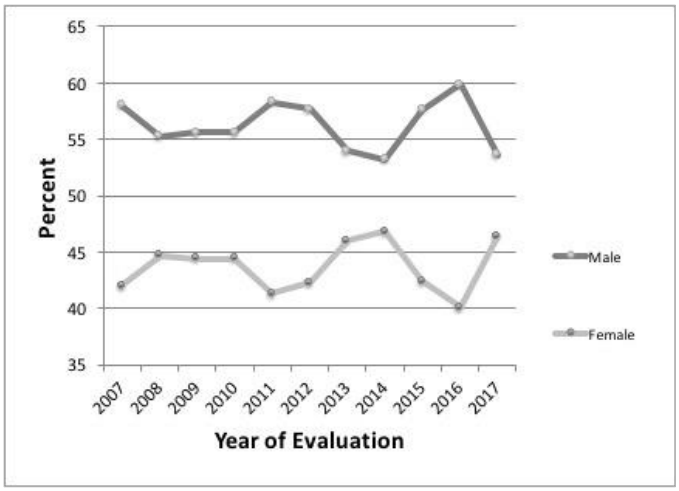

Figure 2.4. Ratio of Recommendations by Gender per Year

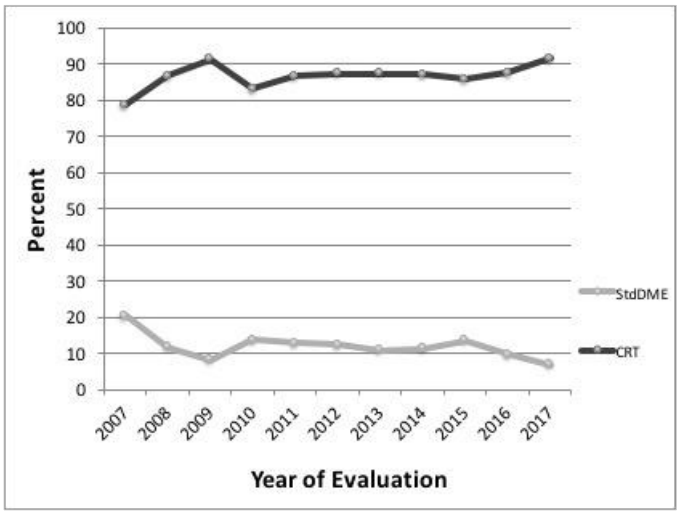

Figure 2.5. Ratio of StdDME to CRT Manual Wheelchair Recommendations per Year

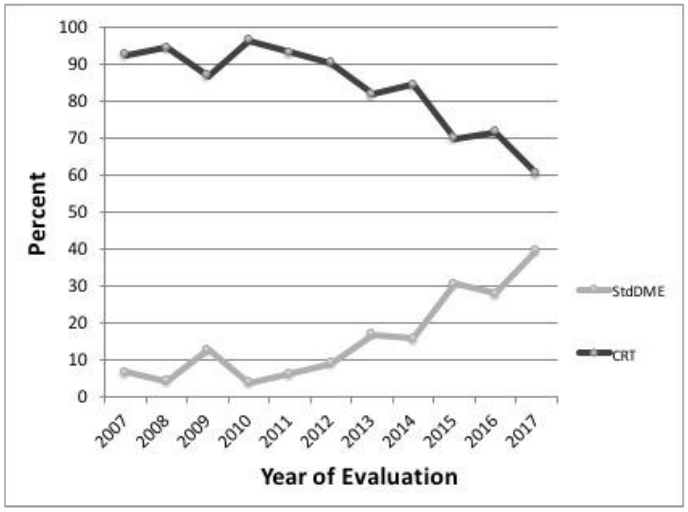

Figure 2.6. Ratio of StdDME to CRT Power Mobility Device Recommendations per Year

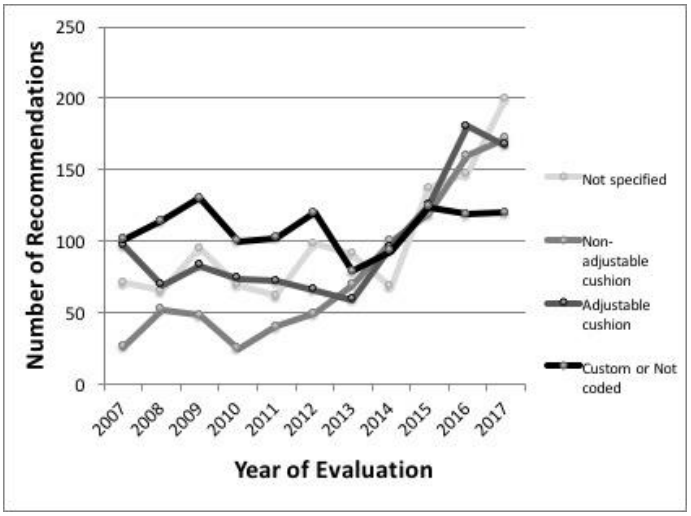

Figure 2.7. Number of Cushion Recommendations by Complexity

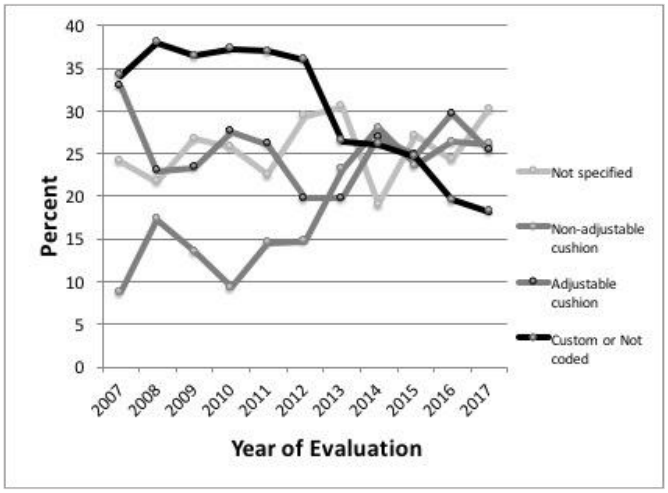

Figure 2.8. Ratio of Cushion Recommendations per Year

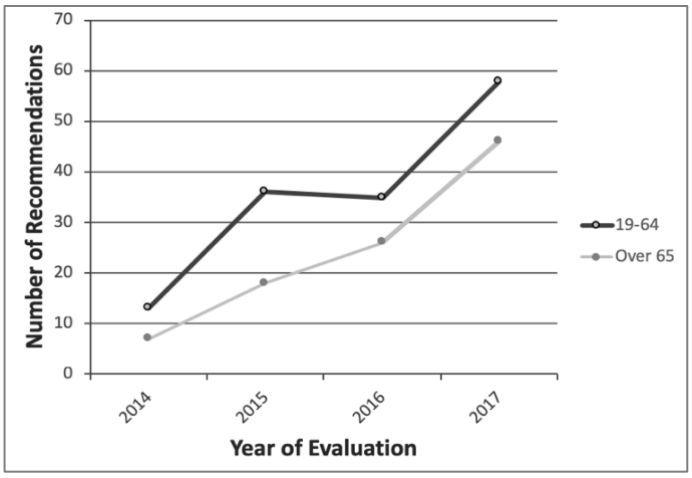

Figure 2.9. Number of StdDME PMDs by Age Category 2014-2017. *Note:* Recommendations for people aged 0-18 excluded due to low counts.

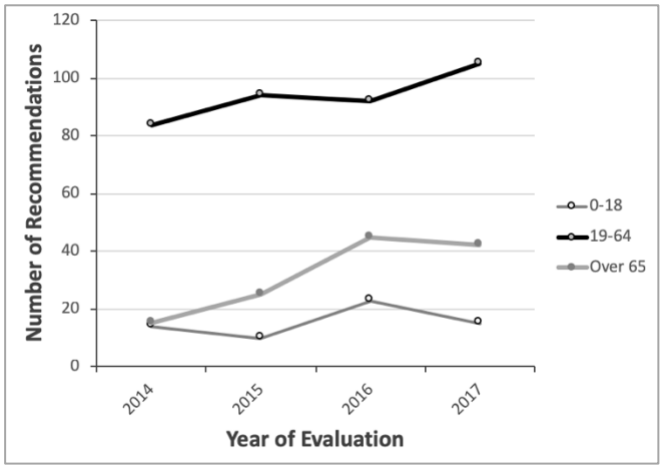

Figure 2.10. Number of CRT PMDs by Age Category 2014-2017

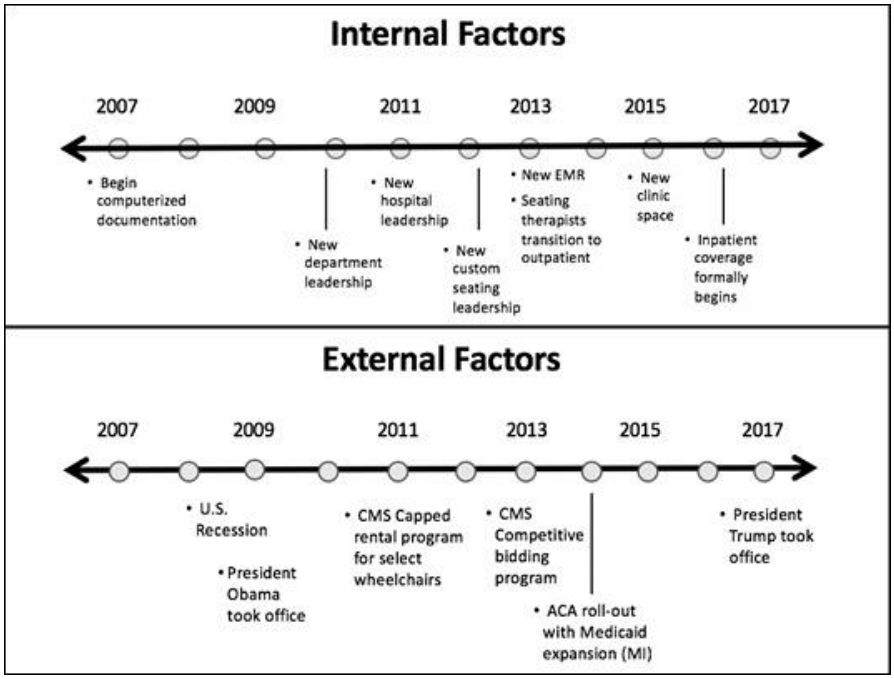

Figure 2.11. Timeline of Internal and External Factors

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CHAPTER III

STUDY TWO

Introduction

The process of procuring a wheelchair in the United States is complex, with many different factors interacting to meet a goal of matching each person with an appropriate wheelchair (Schein et al., 2010). Despite healthcare policies and comprehensive evaluations, instances occur where different equipment is delivered to the person than what was recommended, and long timelines between recommendation and delivery is perceived as a barrier (Dicianno et al., 2018; Sprigle, Cohen, & Davis, 2007). As appropriate wheelchairs and accessories are necessary to support wheelchair users' health and function, it is important that the recommendations decided upon in a comprehensive wheelchair evaluation are carried out in a timely manner (Brienza et al., 2018).

While the person is of primary importance in selecting appropriate wheelchair equipment, there are also many interacting health care factors (Greer, Brasure, & Wilt, 2012; Eggers et al. 2009). Healthcare policy dictates the direct, in-person involvement of two main healthcare professional groups in the selection and recommendation of manual wheelchairs (MWC) with Healthcare Common Procedure Coding System (HCPCS) codes K0005 and above, and power mobility devices (PMD) categorized as a Group 2 PMD and higher (CMS, 2017a, 2017b). These professionals include a licensed/certified medical professional (LCMP) and an Assistive Technology Professional (ATP) certified through the Rehabilitation and Engineering Society of North America and employed by a rehabilitative technology supplier (also known as a durable medical equipment [DME] supplier) (CMS, 2017a, 2017b). The LCMP assesses the client's cognitive, psychosocial, and physical status, assists in selecting the appropriate equipment for

trial, examines the client's fit and function in the wheelchair, documents medical necessity for wheelchair and accessories, and signs off on equipment recommendations (Cooper, Trefler, & Hobson, 1996). While the LCMP may be a physician with specific training in rehabilitation, a physical or occupational therapist most often serves in this role. Complementing the LCMP's role, ATPs employed by DME suppliers' primarily focus on knowing the intricacies of various wheelchair equipment and accessories, completing equipment ordering forms, submitting required forms to insurance, and purchasing, delivering and setting up the equipment (Eggers et al., 2009).

Steps in the process between the equipment recommendation and the delivery may impact what equipment is actually delivered. After the patient evaluation, equipment trials, selection, and recommendation, the DME supplier forwards LCMP and ATP documentation to the funding source for review. The funding source responds to the DME supplier with one of three responses: 1) approval of all recommended equipment, 2) request for additional information, detailing questions that arise during documentation review, or 3) denial of all or part of the equipment recommended. If funding source approves the equipment, it is ordered by the DME supplier and delivered to the client. A request for additional information necessitates a response to questions detailed in the document before a decision is made by the funding source. Similar to requests for additional information, denials may cover the entire recommendation or specific parts or accessories.

The interconnected and multifactorial service delivery process leaves room for failure. Documentation for approved equipment has traveled a complex "paperwork trail" between the LCMP, physician, DME supplier, and funding source, in which equipment approval is dependent on timely sending and receipt from one source to another. On this trail, paperwork may be lost in

transit, and also important communication may be "lost in translation" among the various disciplines that must effectively communicate project status, timelines, and details about the project with each other. Also, in the time between recommendation and delivery, people may change. Their health status may improve or decline, or they may move from one geographic location to another, or one setting to another. Improving timelines between recommendations and delivery increase the possibility that a person receives an appropriate wheelchair, which may prevent future health issues.

While the barriers to receiving what was recommended are great, the service delivery process between equipment recommendation and delivery has rarely been captured in research. Previous articles explain the service delivery process, as depicted from the view of the wheelchair seating expert (Eggers et al., 2009; Greer, Brasure, & Wilt, 2012; Dicianno et al., 2018). Studies have gathered self-reports of adult wheelchair users detailing received wheelchair quality have been gathered and analyzed in relationship to demographics such as diagnosis and funding source (Groah, Ljungberg, Lichy, Oyster, & Boninger, 2014; Myaskovsky et al., 2017). Additionally, DME claims of delivered equipment have been explored to improve understanding of delivered wheelchair equipment in relationship to demographics, as well as LCMP and DME supplier involvement in the process (Sprigle & Taylor, 2017). However, due to the interconnected and dynamic nature of the process, it is necessary to study a clinical population in order to understand the actual impact of the numerous service delivery constructs in relationship with equipment that a person is recommended and receives.

It is possible that no differences exist between recommended and received wheelchair equipment in expert wheelchair seating departments that work closely with DME suppliers, due to the team-based approach taken in wheelchair evaluations and the LCMP and DME supplier's

intimate knowledge of health care policy that govern coverage of wheelchairs and accessories. However, the numerous steps between recommendation and delivery in the process increase the potential for disruptions. Therefore, this study addressed the following research questions:

1. Do differences exist in therapist recommended equipment and DME delivered equipment? If so, does a person's sex, funding source, or complexity of equipment recommended predict if differences are more likely to occur?
2. Are timelines significantly longer when complex wheelchair bases are recommended, or for public funding sources?

Methods

A retrospective pre-test/post-test design was utilized to determine if differences exist between therapist recommended and DME delivered equipment. This study utilized 2017 data from a previous study that looked at therapist wheelchair recommendations made between 2007 and 2017 (Masselink, under review). The data was abstracted from clinical documents in one Midwestern rehabilitation hospital's wheelchair seating department, a clinical setting in which four physical and occupational therapists serve as LCMPs that solely focus on wheelchair seating. In 2017, the seating department was serving people primarily on an outpatient basis, although also evaluated people needing wheelchairs on the inpatient spinal cord unit. When scheduling the evaluation session, patients were asked to choose their own DME supplier, specifically one with an ATP on staff. The ATP was actively involved in the evaluation process, and the external DME supplier ordered wheelchair bases and commercial accessories. An in-house DME supplier coordinated custom wheelchair accessories, including cushions, seat backs, and accessories for complex postural needs.

This study was approved by the Western Michigan University and the rehabilitation hospital's HSIRB committees.

Sample

This study utilized a convenience sample of all documents (letters of medical necessity) and subsequent DME supplier delivery documents for patients seen in the dedicated seating department between January 1, 2017 and December 31, 2017. Records were excluded if the patient did not use one of the two participating DME suppliers, or if the DME supplier did not have the patient information on file or a digital document of the delivered equipment. Additionally, in this study, custom equipment obtained from the in-house custom equipment provider was excluded.

Data Collection

One reviewer manually abstracted and coded the therapist recommendations, with reliability of that sample documented in a previous study (Masselink, under review). The same reviewer abstracted and coded data from the DME supplier delivery receipts. The delivered equipment was matched with the recommended equipment on an Excel spreadsheet (Microsoft, Redmond, WA), and then deidentified.

Analysis

Demographic characteristics included age, sex, diagnosis, and funding source, defined categorically and analyzed as counts and percentages of the category total. Additionally, MWCs, PMDs, power options, cushions, and wheelchair back categories were calculated as counts and percentages of recommended and delivered totals, and counts of non-delivered items. Custom cushion and backs were excluded from the analysis due to a different supplier of this equipment than the participating DME companies.

The sign test with continuity correction was utilized to determine if significant differences existed between recommended and delivered MWCs, PMDs, power options, cushions, and backs. The sign test was utilized over the Wilcoxon signed rank test due to violations of the distributional assumption, as recommended by Laerd Statistics (2015). For this analysis, equipment categories were defined as ordinal variables (Table 1). An a priori analysis for statistical power with a medium effect size ($d = 0.3$), an $\alpha = 0.05$, and power ($1 - \beta = 0.80$) projected a necessary sample size of 57 for the Wilcoxon signed-rank test (matched pairs) (Faul, Erdfelder, Lang, & Buchner, 2007).

A binomial logistic regression was utilized to understand if a person's age, diagnosis, funding source, or complexity of equipment recommended predicted if differences were more likely to occur in MWC and PMD delivered equipment. Two 2-way ANOVAs were used to assess the interaction between funding source (public and private) and PMD and MWC (standard and complex) recommendations on the process length. Public funding sources included Medicare and Medicaid, while private funding sources included commercial, no-fault auto insurance, workers compensation, and other, such as self-pay. Complex MWCs were pediatric and adult tilt-in-space (TIS), complex pediatric and adult MWCs, and other MWCs (sport). Complex PMDs were those in Groups 2a, 3, 4, and 5. The process length was calculated in days between the documented evaluation and delivery date.

Descriptive and inferential statistics were computed using IBM SPSS Statistics Version 23 for Macintosh (2015) (IBM, Armonk, NY).

Results

Table 2 shows that the majority of the 546 participants were male, and most participants were in the 19-64 age category. The most common diagnoses were cerebral palsy (25%), lumbar

spinal cord injuries (SCI) (9%), and musculoskeletal disorders in the ICD-10 Code M category (8%); although the top diagnoses in the specific age categories differed (Table 2). The most common funding sources also differed by age category, with most people in the 0-18 age category having Medicaid only (48%), 19 to 64 with Medicare and Medicaid (29%), and people over 65 with Medicare only (33%).

Overall, 62 (11% of all wheelchairs) full equipment recommendations were not delivered. Tables 3 and 4 show the recommended, delivered, and not delivered equipment counts and percentages for categories of the 315 MWCs, 229 PMDs, 230 power options, 424 cushions, and 412 backs. Nine percent of recommended MWCs and 19% PMDs were not delivered. Additionally, 3.9% of power options, 2.8% of cushions, and 1.7% of backs were delivered with different HCPCS codes than were recommended (Table 4). Analysis using the sign test assessed the impact of the changes from recommendation to delivery and non-delivered equipment on the delivered equipment groups. There were significant differences found between recommendation and delivery for all equipment (MWCs: $z = -5.2$, $p < .001$; PMDs: $z = -6.3$, $p < .001$; power options: $z = -7.1$, $p < .001$; cushions: $z = -7.6$, $p < .001$; backs: $z = -7.8$, $p < .001$).

Binomial logistic regression was performed to determine the effects of sex, age, funding source, and recommended MWC and PMD complexity on differences in delivered MWC HCPCS codes and PMD Groups, including non-delivered equipment. For MWCs, the logistic regression model was significant, $\chi_9 = 36.51$, $p < .001$, explaining 24.5% (Nagelkerke R_2) of the variance in recommended and delivered equipment and correctly classifying 91.3% of cases (Table 5). Sensitivity was 99.3%, specificity was 10.7%, positive predictive value was 91.8%, and negative predictive value was 60%. Of the 12 predictive variables, only one was statistically significant, revealing that for each unit reduction in years of age, the odds of having a different

delivered MWC than recommended increased by 1.07 (95% CI 1.10, 1.04). For PMDs, the logistic regression model was not significant, $\chi_8 = 4.43$, $p = .73$. The model explained 3% (Nagelkerke R_2) of the variance in recommended and delivered equipment and correctly classified 80.4% of cases. Sensitivity was 100%, specificity was 0%, positive predictive value was 100%, and negative predictive value was 0%. Of the 11 predictive variables, none were statistically significant.

The average length from equipment recommendation to delivery was about 6 months (M = 176 days, SD = 98.5). The distribution of process length across standard and complex MWCs was not similar; however, it was for PMDs based on visual inspection. Analyses using the Mann Whitney U revealed that process length was not associated significantly with standard (*Mdn* = 145 days) and complex (*Mdn* = 145 days) MWCs, $U = 2{,}601$, $z = 0.58$, $p = 0.58$; but, was for standard (*Mdn* = 137 days) and complex (*Mdn* = 173 days) PMDs, $U = 4{,}863$, $z = 2.48$, $p = 0.01$. The distribution of process length across public and private funding sources were similar, and the Mann Whitney U revealed that process length was not significantly associated with public (*Mdn* = 156 days) or private (*Mdn* = 142 days) funding sources, $U = 23{,}398$, $z = -1.7$, $p = 0.09$.

Given the significant association between PMD complexity and the length of the process, a two-way ANOVA was run to understand the interaction between funding source and PMD complexity in relation to process length. Outliers were assessed by inspection of a boxplot, in which two were identified and kept in the analysis. Normality was assessed using Shapiro-Wilk's normality test, with violations in each cell of the design ($p < .05$) and homogeneity of variances was assessed and assumptions met by Levene's test ($p = .21$). There was no statistically significant interaction between public and private funding sources and PMDs for process length, $F(1, 178) = .009$, $p = .93$, partial $\eta_2 = .00$.

All pairwise comparisons were run for each simple main effect with reported 95% confidence intervals and *p*-values Bonferonni-adjusted within each simple main effect. The simple main effect of funding source on mean standard PMDs ($F(1, 178) = .59$, partial $\eta^2 = .003$) and complex PMDs ($F(1, 178) = 1.45$, partial $\eta^2 = .008$) was not statistically significant. For standard PMDs, the process length was 30.87 days, 95% CI [-48.49, 110.22] longer for public than private funding sources. For complex PMDs, the process length was 26.6 days, 95% CI [-17.0, 70.2] longer for public than private funding sources.

There was a statistically significant difference in process length between public funding sources and standard and complex PMDs, $F(1, 178) = 5.60$, $p = .02$, partial $\eta^2 = .03$, but not between private funding sources and PMD complexity, $F(1, 178) = 1.27$, $p = .26$, partial $\eta^2 = .007$. For public funding sources, the process length was 43.14 days, 95% CI [7.14, 79.14] longer for complex than standard PMDs. For private funding sources, the process length was 47.40 days 95% CI [-35.67, 130.46] longer for complex than standard PMDs.

Discussion

The purpose of this study was to determine if differences exist between therapist recommendation of equipment and DME delivered equipment, as well as to examine timelines from evaluation to delivery. Although the wheelchair service delivery process is complex and requires collaboration between health-care professionals, equipment suppliers, and the client, in the majority of instances the equipment recommended was delivered. This may be due to the team-based approach and sole focus of wheelchair seating by the study site.

In this study, when wheelchair base recommendations were different than what was delivered, the recommendations were more likely to be cancelled than to be changed for another wheelchair base. Changes in the person's medical status or living arrangements, or insurance

denials, may have contributed to these non-delivered items. Examining wheelchair type and complexity in relationship to differences in recommended and delivered equipment revealed patterns that would not have been seen considering wheelchair type only. Gender, age, public and private funding sources, and MWC complexity were able to predict most of the differences in recommended and delivered equipment. However, the same was not true for PMD differences, although there were more disruptions in PMD recommendations, and complex PMDs recommended to public funding sources for reimbursement were likely to take longer to get delivered than standard PMDs.

Relationship of Results to Literature

Although no studies have explored the relationship between recommended and delivered wheelchair equipment, previous studies have explored the impact of the person's funding source on wheelchair equipment. In those studies, public funding sources have been associated with lower quality wheelchairs, higher risk of pressure ulcers, and more wheelchair repairs with some resulting in adverse consequences (DiVita, Granger, Goldstein, Niewczyk, & Freudenheim, 2015; Groah, Ljungberg, Lichy, Oyster, & Boninger, 2014; Hogaboom, Worobey, Houlihan, Heinemann, & Boninger, 2018). This study found that public funding sources were associated with longer process lengths for complex PMDs than standard PMDs, but funding source was not significantly associated with other factors.

Applying the study results to clinical situations requires consideration of the various known factors. The population of people who have public funding sources are at socioeconomic risk (as eligibility for Medicare or Medicaid requires the person to be over the age of 65, on disability, or low income), and people who need complex PMDs have significant medical conditions with limited movement. It is possible that longer process lengths for people with

public funding sources, complex PMDs and accessories are due to funding source requests or advocacy efforts in between the recommendation and delivery. In the study site, the therapists pursued equipment recommendations and wrote requests for additional information. In instances where equipment was denied, problem solving occurred and, if needed, alternative funding sources were sought. In the previous studies, it is possible that altered recommendations for public funding sources were delivered without question, or that the public funding source in that geographic area was less open to additional feedback, leading to lower quality wheelchair provision.

Strengths and Limitations

The retrospective approach of this study prevented bias in therapist recommendations and delivered equipment; however, the lack of experimental control does prevent causal findings. The inclusion of all participants from 2017 increased the sample size and provided information on pediatric and adult service delivery. The study site of a functioning clinical practice presents a realistic and authentic picture of the factors that may impact delivered equipment. Although therapist recommendations from only one study site were utilized, the use of two DME supplier's delivery information increased the generalizability of the results. Additionally, including custom equipment in the analysis may have changed the results. Care should be taken when generalizing these results to other geographic locations.

Implications for Clinical Practice

The most important implication from this study for clinical practice is the importance of education and follow-up in the wheelchair service delivery process. This study found that in a minority, but still significant number of cases, the recommendations that were made in the wheelchair evaluation were not delivered as expected. A LCMP may only perform the

wheelchair evaluation, recommend equipment, and not follow-up on the results. Additionally, a person may be not be educated about the numerous potential barriers in the service delivery process, and may not be aware of the implications that different delivered equipment may have on their health and well-being. Hansen, Tresse, and Gunnarsson (2004) found that at 3-month checkups by LCMPs, 99% of wheelchairs inspected required some sort of action or maintenance in order to optimize the use of the wheelchair. Such post-issue rechecks and intervention decreased accidents within the study population. Given the increased risk for injury and complication that may accompany inappropriate wheelchair equipment, follow-up services are necessary to support positive outcomes for wheelchair users.

Conclusion

People with PMDs recommended are more likely to wait longer than other types of equipment, and are not as likely to be delivered, especially when public funding sources are involved. Younger age may increase the likelihood of an altered or cancelled MWC delivery than what was recommended; however, the same association was not found for PMDs. Additionally, low complexity and high complexity accessories are less likely to be delivered than other accessories, and consideration should be given to the extended process lengths and number of non-delivered complex PMDs.

These results support follow-up services in clinical practice and indicate that more interdisciplinary research is needed that covers the entire service delivery of wheelchair equipment, beginning at evaluation and monitoring through follow-up. Additionally, future research should strive to better understand the limitations that people with public funding sources and complex equipment needs face. The impact of funding source and equipment complexity should be considered within the context of equipment type and other factors; and studies should

measure equipment complexity, not just equipment type (MWC or PMD), to relate results to the current equipment coding structure used by funding sources.

Table 3.1
Manual Wheelchair and Power Mobility Device Categories by HCPCS Codes

Wheelchair base	Definition
Manual wheelchairs (MWC)	
Standard adult	K0001 – K0004 , K0006, K0007
Pediatric Tilt-in-space (TIS)	E1231 – E12434
Adult Tilt-in-space (TIS)	E1161
Complex Pediatric	E1129, E1235 – E1238
Complex adult	E1120, K0005, K0009
Other	Sport, Titanium frames
Power mobility devices (PMD)	
Power operated vehicle (POV)	
Group 2	K0813 – K0816
Group 2a	K0820 – K0829, K0835 – K0843
Group 3	K0848 – K0864
Group 4	K0868 – K0880

Table 3.2
Demographic Characteristics of Sample

Variable		Count	%
Sex	Male	290	53.1
Age	0-18	159	29.1
	19-64	296	54.2
	65 and over	91	16.7
Diagnoses			
Young age (0-18 years)	Cerebral Palsy	65	40.9
	Congenital malformations	21	13.2
	Spina Bifida	20	12.6
Middle age (19-64 years)	Cerebral Palsy	65	22.0
	Thoracic SCI	36	12.2
	Lumbar SCI and amputations	29	9.8
Older age (over 65 years)	Musculoskeletal system and tissue	17	18.7
	Lumbar SCI and amputations	14	15.4
	Diseases of the circulatory system	12	13.2
Primary and secondary funding sources			
Medicare or Medicare HMO	Primary	50	9.2
	With Medicaid	110	20.1
	With other funding source	34	6.2
Medicaid or Medicaid HMO	Primary	145	2.7
	With other funding source	14	2.6
Private insurance	Primary	42	7.7
	With public funding source	94	17.2
No-fault, Workers comp, VA, or other	Primary	35	6.4
	With other funding source	22	4.0

Note. Percentages calculated using total for all participants, except for diagnosis where percentage is calculated using age category. "Other funding source" includes private insurance, no-fault auto insurance, workers compensation, department of Veteran's Affairs (VA), or other funding source (self-pay or charity). "Public funding sources" include Medicare, Medicare advantage plans, Medicaid, or Medicaid HMO plans.

Table 3.3
Descriptive Characteristics of Recommended and Delivered Wheelchair Bases

Wheelchair base	Recommended Count (%)	Delivered Count (%)	Not delivered Count
Manual wheelchairs (MWC)			
Standard adult	22 (7)	20 (4)	*
Pediatric TIS	25 (8)	23 (7)	*
Adult TIS	72 (23)	65 (21)	7
Complex Pediatric	83 (26)	80 (25)	*
Complex Adult	107 (34)	95 (30)	12
Other	6 (2)	5 (2)	*
Power mobility devices (PMD)			
POV	47 (17)	39 (17)	8
Group 2	49 (16)	37 (16)	12
Group 2a	6 (3)	3 (1)	*
Group 3	120 (52)	98 (43)	21
Group 4	7 (3)	8 (4)	0

Note. See Table 2 for category definitions. Percentage of total equipment type.
* not reported due to counts lower than 5.

Table 3.4
Descriptive Characteristics of Recommended and Delivered Accessories

Accessories	Recommended Count (%)	Delivered Count (%)	Not delivered Count
Power options			
PMD with no power options	100 (44)	81 (44)	20
Elevating legs or seat elevator	6 (3)	5 (3)	*
Tilt or recline	33 (14)	31 (17)	*
Tilt or recline with elevating legs or seat elevator	27 (12)	21 (11)	8
Tilt and recline	8 (4)	8 (4)	
Tilt or recline with elevating legs and seat elevator	9 (4)	*	*
Tilt and recline with elevating legs or seat elevator	24 (10)	14 (8)	8
Tilt, recline, elevating legs, and seat elevator with or without active reach	16 (7)	15 (8)	*
Tilt, recline, elevating legs, seat elevator, and/or standing	7 (3)	7 (4)	*
Cushions			
Standard	130 (31)	112 (26)	22
General use	36 (9)	31 (7)	7
Skin protection or positioning	39 (9)	34 (8)	7
Skin protection and positioning	104 (25)	90 (21)	10
Skin protection, adjustable	63 (15)	57 (13)	*
Skin protection and positioning, adjustable	52 (12)	38 (9)	12
Backs			
Standard	234 (56)	193 (47)	43
General use	30 (7)	29 (7)	0
Positioning, posterior	111 (27)	93 (23)	*
Positioning, planar	36 (9)	34 (8)	18

Note. Power mobility device (PMD). Percentage of total equipment type. Cushions and seat backs do not include recommended custom options. * not reported due to counts lower than 5.

Table 3.5
Logistic Regression Predicting the Likelihood of Different Delivered MWC Than Recommended

	B	SE	Wald	*df*	*p*	Odds Ratio	95% CI for Odds Ratio	
							Lower	Upper
Male	.40	.45	.78	1	.377	1.49	.62	3.61
Years of age	-.07	.02	18.63	1	<.001	.93	.91	.96
Public insurance			3.72	3	.293			
Medicaid only	-.79	.85	.85	1	.356	.46	.09	2.43
Private insurance	-1.58	.94	2.80	1	.094	.21	.03	1.31
Other	-.62	.95	.43	1	.511	.54	.08	3.45
Standard MWC			4.52	4	.341			
Pediatric TIS	-.45	.76	.35	1	.557	1.56	.35	7.00
Adult TIS	-1.90	1.04	3.34	1	.067	.15	.02	1.15
Complex pediatric	.28	.59	.23	1	.634	1.32	.42	4.16
Complex adult	-.85	.89	.91	1	.339	.43	.07	2.45
Constant	5.73	1.25	20.90	1	<.001	309.23		

Note. Public insurance includes Medicare only, Medicare or Medicaid with secondary insurance. Private insurance includes private insurance only, or with Medicare or Medicaid secondary. Other includes no-fault auto insurance, worker's compensation, Department of Veteran's Affairs, with or without a secondary. "Other" recommended MWC were excluded from this analysis due to low numbers and as they are not funded by healthcare insurance.

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CHAPTER IV

STUDY THREE

Introduction

Over the years, experts have described models for the service delivery of wheelchairs. Batavia et al. (2001) specified constructs consisting of the individual, wheelchair, and environment as well as factors of fit, access, and disability that came together for function. Eggers et al. (2009) investigated literature and conducted expert interviews to propose a linear model with healthcare system factors and wheelchair service delivery both influencing appropriateness of the wheelchair and subsequent health and safety, participation, and satisfaction outcomes. Moreover, the authors delineate factors that are found in the comprehensive "needs assessment" process (p. 1033). Greer et al. (2012) recommended that the wheelchair service delivery include three main parts: "patient evaluation", "equipment selection and delivery", and "after delivery services" (p. 143) and described subsequent components of each based on previous literature.

Although the frameworks have laid the basis for studies, few have examined criteria contributing to best practice processes in clinical practice. In an acute care setting, a 5-step intervention process incorporating best practice criteria was shown to increase the person's use of their wheelchair in their community setting (Hoenig et al., 2005). Qualitative observation and expert consensus were used as the foundation to create a comprehensive seating assessment to guide best practice in wheelchair seating in the UK and Ireland (Wright, Casey, & Porter-Armstrong, 2010). In a study examining methods to extend knowledgeable wheelchair services to rural areas, telerehabilitation with a knowledgeable wheelchair seating therapist resulted in similar outcomes to in-person evaluations (Schein et al., 2010).

The goal of the wheelchair service delivery process is to fit a person with an appropriate wheelchair that supports the comfort, health, and function of the wheelchair user (Brienza et al, 2018). Hunt et al. (2004) found that for people with spinal cord injury, more complex manual wheelchairs (MWC) and power mobility devices (PMDs) with customizable and programmable features are appropriate. Lower quality wheelchairs have been linked to less independence and safety with wheelchair use and functional tasks requiring upper extremity use, as well as restricted upper extremity active range of motion compare with those who use higher quality wheelchairs (Brienza et al., 2018; Sabari, Shea, Chen, Laurenceau, & Leung, 2016). Additionally, lab tests have shown that compared with higher complexity, "rehabilitation" MWCs, lower complexity "depot" do not hold up as well and are even more costly over time to maintain (Cooper et al., 1996). As wheelchair use in the United States is expected to quadruple by the year 2030, evidence-based best practice methods are necessary to improve the health and function of wheelchair users by guiding an appropriate fit, as well as reduce the risk of wheelchair-related injury (Flagg, 2009).

As higher quality wheelchairs are more appropriate for everyday use, the evaluating team must be able to support higher quality wheelchair recommendations through the service delivery process. The expertise of suppliers and providers has been cited as a reported facilitator in the service delivery process (Dicianno et al., 2018). Also, the expertise of the wheelchair seating clinic has shown to contribute to higher quality wheelchair recommendations (Myaskovsky et al., 2017). The use of physical and occupational therapists serving in the expert role is important, as without the therapist input, the equipment recommendation may be less person and function focused and more product focused (Cooper, Trefler, & Hobson, 1996). However, specific details

describing how experts facilitate the match between the person and the equipment, and how they support wheelchair users, over time are lacking.

This research study aims to explore physical and occupational therapy documentation from a dedicated, expert team of wheelchair seating therapists working in a consultative model of care to determine how often, and for what reasons, patients seek the services of expert therapists in wheelchair seating. The consultative model of care consists of client-centered services that address specific needs in short-term (often one to three visit) episodes of care; however, many patients need multiple episodes over time to meet changing needs. It was expected that using a team of expert wheelchair seating therapists for this study would provide insight into best practice in the wheelchair service delivery process. To identify patterns, the person's age, sex, diagnosis, and wheelchair complexity were also considered. The documentation resulting from skilled seating services was explored to identify the perceived need for services, intervention activities utilized in the sessions, and session outcomes. The purpose of the study was to build a greater understanding of the wheelchair service delivery process from a physical or occupational therapist's viewpoint.

Methods

A retrospective chart review was completed of documentation from 2007 to 2017 from one Midwestern rehabilitation hospital's wheelchair seating department. Physical and occupational therapists equaling four full time equivalents worked in the dedicated seating department over the time period. All therapists underwent an intensive, 6-month long orientation to wheelchair seating and received their Assistive Technology Professional (ATP) certification from the Rehab and Engineering Society of North America within two years of working in the department. They worked closely as a team with various DME suppliers in the area.

In a previous study, letters of medical necessity (LOMNs) detailing full wheelchair recommendations (including a wheelchair base and cushion) made between 2007 and 2017 were explored (Masselink, under review). This study examined all documentation from patients in that study, defined as "recurring patients", who had two or more full wheelchair recommendations in the 11-year time period. The longitudinal, mixed-methods approach for the present study consisted of a quantitative, descriptive design and a qualitative, grounded theory approach to answer the above-noted research questions. The grounded theory approach utilized artifact review to confirm suspected need for services, session activities, and visit outcomes, while providing space for greater understanding.

This study was approved by the Western Michigan University and the rehabilitation hospital's HSIRB committees.

Sample

This study utilized a convenience sample of all documents for patients who had two or more full wheelchair evaluations in the department between January 1, 2007 and December 31, 2017. All documents for recurring patients were examined for the quantitative portion of the study. The qualitative portion of the study examined deidentified documentation from patients in the 0-18, 19-64, and over 65 age categories. Documentation was deidentified to reduce bias by the researcher during data review, as the researcher had worked in the department during the study years. The participants were randomly ordered within the age groups to achieve a representative sample and all documents for one patient were reviewed and analyzed at a single time.

Analysis

A descriptive analysis was performed of the entire sample. This included patient demographics of age, sex, and diagnosis. Age categories were defined considering significant transition ages for public and private health care sources. This resulted in five categories of age in 2017 of under 18, 18-27, 28-64, 65-74, 75 and over. This approach accommodated people who were under the age of 18 the duration of the study period, those who passed over the age of 18 during the study period, those who were aged 19-64 during the entire study period, those who passed over the age of 65 during the study period, and people aged over 65 for the duration of the study period. Sex was coded as a dichotomous variable (male/female).

Diagnoses were organized into 15 categories based on ICD-10 coding, after examination of counts per category (Centers for Medicare and Medicaid Services, 2010). Endocrine, nutritional, and metabolic disorders included diagnoses in ICD-10 code group E, such as diabetes mellitus and obesity. In ICD-10 code group F, mental, behavioral, and neurodevelopmental disorders included Rett's syndrome and autism. The ICD-10 code group G, diseases of the nervous system, included Huntington's chorea, Friedrich's ataxia, and Guillain-Barre syndrome. Examples of diseases in ICD-10 code I, diseases of the circulatory system, included coronary artery diseases and congestive heart failure. ICD-10 code M, diseases of the musculoskeletal system and connective tissue, included rheumatoid arthritis and osteoarthritis. Congenital malformations, ICD-10 code Q, include arthrogryposis and Angelman syndrome.

Documents were described by three code categories: document purpose, contact type (in person or remote) and wheelchair complexity (standard and complex). The document's purpose was categorized as either: 1. Full wheelchair recommendation, 2. Partial wheelchair recommendation (consisting of accessories and parts), 3. Documentation of clinical services

only, or 4. Justifying previous recommendations. All clinical sessions included education and training; however, to maintain mutual exclusivity in the categories, the document was only coded as "clinical services only" if there were no therapist equipment recommendations (categories one and two), and if the document did not address a request for additional information or provide additional support to previous recommendations (category four). Documentation frequency equaled counts of the number of documents written for each patient in the 11-year time period. Length of patient encounter was measured from the date of the first document after January 1, 2007 to the date of the last document prior to December 31, 2017; average length between documentation was calculated by dividing the number of documents written per person by the length of the patient's encounter. The complexity of the wheelchair that served as the focus for each document was coded as standard or complex, and in instances where more than one wheelchair was addressed, the highest complexity wheelchair was coded. Standard and complex wheelchairs were defined in Masselink (under review).

Bivariate analysis examined group differences of the frequency of documentation and average length of time between documentation by age, sex, and diagnosis. Additionally, evaluation documentation types and requests for additional information were examined in the categorical age groups defined above. IBM SPSS Statistics Version 23 (IBM, Armonk, NY) for Macintosh (2015) was utilized for the statistical analysis.

Qualitative Analysis

Qualitative analysis took an inductive approach, in which code creation emerged from patterns in the data. The participants for three age categories (0-18, 19-64, and over 65) were randomly organized within the age categories, then the first ten participants' documents were blinded by the primary investigator's research assistant prior to review by the primary

investigator. The research assistant was trained to utilize a systematic written procedure to complete this process. She was required to demonstrate efficacy in the procedure with two participants prior to initiating the formal process. The blinded documents were then returned to the primary investigator for analysis. This was done in an effort to reduce bias in the selection and coding of the documents, as the researcher had worked in the department during the study time frame.

Data was abstracted for greater understanding of the patient's need for services, session activities, and the visit outcomes. Qualitative analysis occurred for each age category to saturation, using the constant comparative method by Glasure and Strauss (1967), as utilized by Bowen (2009). Participant documentation was stratified for review by age (0-18, 19-64, and 65+). All individual participant documents were analyzed at one time. An initial reading of a participant's documents reviewed the information, and code analysis started on the second reading. Codes emerged from the documents, from which categories were created using content-analysis. Common codes were formed into categories for that person, which were reviewed in context with previously gathered information. If new categories emerged, previous participant data were reviewed in light of the new categories.

After categories were created for each age group, thematic analysis occurred. To do this, excerpts and codes from all age categories were examined within each group with resulting themes established, then the themes for all age categories were reviewed in the entirety. Themes were created from common codes considering frequency of code use and fit in the therapeutic process. Codes that did not fit into specific areas were then examined together, which formed two additional categories. Descriptive and meaningful themes were considered.

Rigor

As the lead investigator was an insider to the facility for the years analyzed, the documents were blinded to prevent potential bias affecting the qualitative analysis. Credibility was addressed using peer debriefing strategies with another occupational therapist, an outsider to the facility. Strategies of reflexivity during the abstraction and analysis, as well as transparency by using and disseminating all information gathered, were used to address rigor; utility was addressed in the study design (Ballinger, 2004).

Results

The participants were mostly between the ages of 0-17 and 28-64, with a smaller group of 18-27-year-olds and fewer people over the age of 65 (Table 1). Although the 65 to 74 and over 75 age groups were small, a review of the most frequent diagnoses in the two groups revealed differences with more individuals with cerebral palsy (CP) and cervical SCI in the 65-74 age group, and more individuals with cerebrovascular and musculoskeletal system and tissue diseases in the over 75 age group. Therefore, these two groups were analyzed separately. This study sample represented primarily neurological diagnoses; one out of every four people were diagnosed with CP, followed by cervical SCI (Table 1). Two thousand, two hundred and ninety four of the documents were focused on wheelchairs in the complex rehabilitation category, while 165 were focused on wheelchairs in the standard durable medical equipment category. Due to the small number of standard wheelchairs, further analysis of the differences in wheelchair complexity was not pursued. Distributions of the number of documents for males and females were similar, as assessed by visual inspection. By Mann-Whitney U test, the number of documents was statistically significantly different between males (*Mdn* = 4) and females (*Mdn* = 4), $U = 30{,}712$, $z = -2.350$, $p = 0.02$.

Most participants had three documents written over the 11-year time period, although that ranged greatly from two to 17 (Table 2). The average length of time between documents was about 1.5 years for each age category except over 75, who had an average of less than a year between documents (Table 3). A Kruskal-Wallis H test was run to determine if there were differences in the median number of documents completed between the five age groups. Median number of documents was statistically significantly different between groups, $\chi_2(4) = 24.6$, $p = <.001$. Pairwise comparisons were performed using Dunn's (1964) procedure with a Bonferroni correction for multiple comparisons. This revealed statistically significant differences in the median number of documents between the 0-17 (mean rank = 281.4), and 28-64 (mean rank = 237.4) age groups, 18-27 (mean rank = 316.3) and 28-64 age groups, and 28-64 and 65-74 (mean rank = 348.9) age groups.

The number and distribution of documents in the different diagnosis categories varied in the number of documents, encounter length, and subsequent average time between documents. The majority of diagnoses had an average of 1-1.5 years between documents; however, people with systemic atrophies had, on average, four times longer between documents (2.1 years) than people with diseases of the circulatory system (ICD-10 M) (0.5 years) (Table 4). Due to the small sample size per category, no bivariate analysis was completed for this group.

Full wheelchair recommendations accounted for 1,210 documents (or 2.25 per person), with only a maximum of 25% difference in the percentage of full wheelchair recommendations written per person noted between the age groups (Table 5). The greatest range of documents per person between the age groups occurred with partial wheelchair recommendations, with an over 100% difference in the 65-74 and over 75 age categories. There were 634 total partial wheelchair recommendations with an average of 1.2 per person. Counts for services only were less, with 418

total (0.8 per person), and only half of the population needed documentation supporting previous recommendations (224 total documents). Due to the violations of normality, existence of outliers, and small sample sizes, bivariate analysis was only performed to determine if differences existed in the median full wheelchair recommendations between the five age groups. A Kruskal-Wallis H test was performed, revealing that the median number of full wheelchair recommendations was statistically significantly different between the five age groups, χ_2 (4) = 16.55, p = .002. Distributions of full wheelchair recommendations were not similar for all groups, as assessed by visual inspection of boxplot. Pairwise comparisons were performed using Dunn's (1964) procedure with a Bonferroni correction for multiple comparisons. Adjusted *p*-values are presented. This post-hoc analysis revealed statistically significant differences in the full wheelchair recommendations between the 28 to 64 (mean rank = 248.7) and 18 to 27 (mean rank = 304.3) (p = .001) age groups, but not any other group combination.

In total, the 0-17 age group presented with 932 documents, 18-27 with 442 documents, 28-64 with 936 documents, 65-74 with 97, and over 75 with 79 documents. The majority of the documents were written in conjunction with an in-person encounter. However, 106 (11.4%) of documents written for people 0-17 were in addition to in-person encounters, 61 (13.8%) for people 18-27, 67 (7.2%) for people 28-64, 6 (6.2%) for people 65-74, and 11 (14%) for people over the age of 75.

Diagnoses of systemic atrophies, such as spinal muscular atrophy, and diseases of the myoneuronal junction and muscle, such as muscular dystrophy, had the most full equipment recommendations per person (Table 6). People with diseases of the circulatory system had the lowest proportion of full equipment recommendations per person; however, 4 out of 11 people with this diagnosis were in the over 75 age category. The greatest range of documents per person

between the diagnoses occurred with partial wheelchair recommendations, where people with a TBI were six times more likely to need partial equipment recommendations than people with a thoracic SCI. People with cervical SCI and CP consistently required higher proportions of documentation per person, except for documentation supporting previous services. Six diagnoses categories had over five documents supporting previous recommendations: CP (111, 56%), myoneuronal diagnoses (23, 55%), ICD-10 group Q (19, 48%), spina bifida (18, 47%), ICD-10 group E (8, 47%), and cervical SCI (13, 27%). Due to the small sample size per category, no bivariate analysis was completed for this group.

Qualitative Results

Qualitative document review identified the reasons that people need skilled wheelchair services, the session activities that occurred, and the visit outcomes. Data was abstracted from 13 participants' documentation (56 total documents), with the majority of participant's presenting with neurological diagnoses that included cerebral palsy, cervical spinal cord injury, and muscular sclerosis. Participants presented with a variety of cognitive and physical abilities. The qualitative review confirmed the needs for services, session activities, and visit outcomes; however, two additional categories emerged from the data, follow-up services and the team approach.

Team Approach

The team approach embraced the dedicated seating services with themes including client-centeredness, caregiver involvement, and interdisciplinary collaboration. Client-centeredness emerged as a primary theme in the expert-facilitated process, with both verbal and nonverbal wheelchair users. In the documents, this came through the description of personal mobility goals and preferences, client statements prior to proceeding with recommendations or additional trials,

consideration of the wheelchair user's home and community contexts, and the roles the person identified with, such as "husband" and "father". Family surrounding the client, including parents, spouses, and children, as well as grandparents, niece or nephews, or consistent paid caregivers, supplemented the client's report or gave a first-hand account of mobility needs when the person was not able. The documentation included the people at the session, those that the wheelchair user lived with, and the type and amount of care they provided. Examples of personal support provided included repositioning or transporting people with dependent mobility needs, helping the person develop independent functional mobility, performing activities of daily living, and navigating funding source restrictions. Age differences were noted with community contexts; descriptions of the child's school were included, whereas with adults, their vocational participation and community involvement were reported.

Interdisciplinary collaboration was evident in the team approach. Other professionals integral to the wheelchair seating procurement process were most often external DME providers, although internal custom equipment technicians, concurrent therapy providers, such as inpatient or outpatient physical or occupational therapists, and case managers were present in some sessions. Concurrent and previous therapy, such as Driver's Rehabilitation programs or therapy in the school system, and other medical involvement wound clinic treatment, including physician medical appointments, were documented to achieve an understanding of the wheelchair user's context and support need for the equipment. The documentation described other professional's input, and were also used to advocate for equipment when requests for additional information or equipment denials occurred during the funding process. In these cases, the wheelchair seating therapists drew on the person's unique situation along with the health-care team's input to respond to the funding source and provide greater support behind the need for the equipment.

In instances where other professionals were not directly involved in the evaluation or equipment setup, the wheelchair seating therapists' documentation served as a communication tool to direct the equipment ordering, setup, and configuration of the person's recommended equipment. In these instances, physical measurements, specific areas that custom modifications would be needed, directions for accessory placement, or power wheelchair programming were described to improve the person's outcomes.

All team members collaborated to problem solve and find appropriate solutions. Wheelchair users and/or caregivers presented to the sessions with specific problems, such as concern about transporting the equipment, worn parts on their wheelchair, or worry that the person was not comfortable in their seating. Throughout the session, the therapists addressed these concerns with a thorough assessment of the person and of their current wheelchair. Then, equipment adjustments, active trials, and education were utilized to find a solution.

The team approach in skilled wheelchair seating appeared to support the wheelchair user by addressing the wheelchair user's specific and unique needs through a multi-faceted but systematic approach that advocated when necessary.

Need for Services

The reasons why people sought skilled wheelchair seating services were confirmed in this study in two main areas; the evaluation of the wheelchair user's current equipment or the need for new equipment. The needs documented ranged from general to specific and focused on the wheelchair base or accessories themselves, the person's fit or position in the equipment, or the person or caregiver's use of the equipment.

Session Activities

Session activities included the information gained or given by the physical or occupational therapists in the documentation. The presence of session activities in the documentation was confirmed, with three themes revealed: history, assessment, and equipment. The documentation of the wheelchair user's history and the assessment was quite similar to a traditional occupational or physical therapy evaluation in many ways. The person's documented history included their demographic information, diagnoses, and extensive prior medical history, including comorbidities, medications, surgery history, history of the current injury, and concurrent therapy involvement. Recently changed medical status, including weight gain or loss, pressure injuries, falls or injuries, and physician visits were detailed, and the physical and social environments (as described in the team approach) of the wheelchair user were documented. The person's living situation included description of the physical structure of the home, such as egress into and out of the home, accessibility of the doorways, and any completed or planned renovations.

An in-depth assessment of the wheelchair user was documented from a detailed mat evaluation that examined the person's posture, sensation and integumentary system (including pain), range of motion and tone, and physical measurements. Documentation of person's functional mobility, included ambulation, mobility with equipment use, transporting items, and transfer status. Other body systems, including bowel and bladder function, cardiac and respiratory function, visual perception, and neurological function (such as reflexes and seizures) contributed to the review. Other functional areas assessed included activity of daily living (ADL) performance, upper extremity function, communication, and cognition. Basic ADLs such as dressing, bathing, self-feeding, and toileting were always documented; additional instrumental

ADLs such as home management and meal preparation were addressed as appropriate. Grasping patterns, such as use of tenodesis, hand dominance, and coordination were addressed by assessment of upper extremity function. The person's communication style and cognitive status were examined by engagement in the session, ability to follow directions, demonstration of safety with device use, and social communication.

In addition to the person, their wheelchair equipment and equipment needs were addressed in detail. The therapists documented full equipment assessments that detailed the wheelchair frame, seating, and accessories, key measurements, and equipment condition, as well as the length and frequency of use. During this time the therapists also gathered detail on the person's other equipment, from compression stockings to back-up wheelchairs, wrist splints to ankle foot orthosis. In pediatric and middle adult age groups, the transportation method was always described. Methods ranged from dependent mobility in public transportation to a school bus, from driving with hand controls to riding in their wheelchair secured by transit brackets in an adapted van.

The sessions included active equipment trials, education and collaboration (with the person and interdisciplinary team) about potential equipment options. The trialed equipment, including the manufacturer and model of the wheelchair frame, and wheelchair configuration were described, as well as clinical observations of the person using the trialed equipment. Problems during the trials were noted and alternatives discussed with the person and team, and then trialed. Even in instances where the recommendation was to stay with their current equipment or equipment style, such as specific drive wheel configuration on a power chair, many times appropriate alternatives were presented, trialed, and discussed. Other education included topics such as pressure relief strategies, purpose of specific wheelchair components and their use,

equipment availability or potential for customization, and funding source interaction. Sometimes during the active equipment trials the therapist or DME provider (if present) adjusted the person's current equipment. Examples include power wheelchair modifications, additional padding added, or components adjusted, such as the person's backrest.

The in-depth history and assessment contributed to intentional equipment trials and adjustments in an effort to support the patient's wheeled mobility needs in a purposeful manner.

Visit Outcomes

The presence of visit outcomes was confirmed in the document review. Outcomes were related to the need for services and session activities in many ways, with the key themes emerging as enabling independence and facilitating improvements, often through recommended equipment. Independence was enabled with repositioning ones-self and controlling the wheelchair, as well as in caregivers providing dependent mobility and equipment maintenance. Details such as adjusting power tilt functions for access through a switch rather than a toggle box enabled independent repositioning, and programming directions improved independent wheelchair control.

Improvements were facilitated in a variety of physical and functional areas. The majority of skilled wheelchair seating services sought to address the person's static seating position and sitting tolerance through accommodation for tone and physical deformities and/or improvements in the integumentary and circulatory system, reducing risk of pressure injuries. Improved participation and engagement in functional tasks, including functional mobility, ADL performance, and social participation were also revealed as outcomes. To maximize outcomes, the concept of "adaptability" emerged. Specific equipment was noted to improve the ability of the person or caregivers to adequately change the equipment position or remove components

during transfers, transportation, inconsistent tone, or even when clothing needs change with the seasons. Consideration of safety and education provided to support independence and improvements was also documented.

Lastly, equipment procurement supported the physical and functional outcomes. The documentation detailed if equipment delivery would be completed with therapist present, the DME company assistive technology professionals, with custom equipment technicians, or a combination of the three. The equipment recommended for delivery was categorized as wheelchair bases, commercial and/or custom seat and back systems, commercial and/or custom accessories, and power options. When able, the equipment was reused or refurbished to continue meeting the person's needs while minimizing costs.

Follow-Up

Follow-up services were categorized into two areas: execution of the treatment plan and funding source interactions. At times, the person needed additional assessment, equipment trials, or fit and training of equipment after the first evaluation session that necessitated follow-up. Additional assessments included home assessments and pressure mapping evaluations. Home evaluations were necessary to ensure equipment fit in the home, such as navigation through tight doorways with a power wheelchair, while pressure mapping provided additional information to guide cushion recommendation. Additionally, in many instances the therapist documented future needs post-present encounter. For example, noting a child may need new equipment who was moving to a larger school the next year, or casters that were becoming worn and would need replacing in the next 6-12 months.

Funding source interactions were present in the need for services, session activities, and visit outcomes. Repeated evaluations or re-evaluations, caregiver reports of unfunded equipment,

and patient reports of private pay items due to denials were revealed. The funding sources responded to some equipment requests with requests for additional information, acknowledgement of code changes, or a denial for the requested equipment. In those instances, the therapist responded with a letter clarifying key points as requested or acknowledging code changes, taking on an advocating role. In the instances of denials, either a letter was written or a re-evaluation was completed to support the client's needs. In all funding source interactions, the therapist acknowledged the funding source decision and either supported the previous equipment recommendations that were made with added details or in the case of second attempts, spoke with the wheelchair user and adjusted the equipment recommendations for a more conservative option.

Discussion

Examining the quantitative and qualitative results together demonstrates how often, and for what reasons, patients seek dedicated wheelchair seating services. Most people had two full wheelchair recommendations over the 11-year time period, which is to be expected as the number of wheelchairs a health care insurance will cover and the time frame is restricted by health care policy. For example, Medicare will not cover a replacement wheelchair less than 5 years apart (DMEPOS, Summer 2019). However, the participants had four average documents per person. For each wheelchair that was recommended, one to two partial equipment recommendations were made per patient, and around one "service only" visit. This suggests that skilled wheelchair seating services should not be seen as a one-time evaluation, but instead a dynamic service that needs modifications and/or education based on a patient's changing needs.

This study explains the multi-faceted burdens that dedicated wheelchair seating departments face. First, the session exploring the person's history, completing an in-depth

assessment, and equipment trials requires time; session lengths of 1.5-2.5 hours and more were routinely noted in the documents. The consultative nature of dedicated seating services requires time; however, this is much different than an encounter-based outpatient therapy model with 45-minute to 1-hour long sessions. Health care companies may not understand the difference and may deny the extra charges. Additionally, the percentage of documents written after in-person clinical encounters advocating for the person's equipment recommendations revealed more non-billable burden on skilled wheelchair seating departments. This burden appears around 11-14% for people on the ends of the age spectrum, and lower for people in the middle adult stage. However, the burden for older adults may not be representative of all people over the age of 75, due to the small sample size. It is possible that this is due to public funding sources requesting additional information; however, additional investigation in this area is warranted to understand this further. Despite these difficulties, this study also supported the need for skilled wheelchair seating departments to act as facilitators within a team approach to equipment recommendations and advocators to funding sources.

Relationship of Results to Literature

This study supported previous literature in many ways. Eggers et al. (2009) and Greer et al. (2012) reported that a person's age, diagnosis, physical, cognitive, and psychosocial context were critical to matching a person with an appropriate wheelchair and accessories. The session activities in this study found an extensive history and physical, cognitive and psychosocial assessment in addition to examination of the person's current equipment as critical to this process. Additionally, Eggers et al. (2009) reported on the client, physical or occupational therapist as stakeholders in the selection appropriate equipment. This study found a comprehensive team approach necessary to meet the person's wheelchair seating needs, and that

the therapists facilitated the process through assessment, equipment trials, and follow-up services. Myaskovsky et al. (2017) found that wheelchair users seeking services in clinics with specialty providers had a greater chance of receiving a higher quality manual wheelchair; the great difference between standard and complex wheelchairs (165 standard wheelchairs compared to 2,294 complex) supports those results.

The need for support beyond initial equipment recommendations, as Hansen, Tresse, & Gunnarsson (2004) found, was substantiated with the need for partial equipment recommendations and therapeutic service visits in between full wheelchair recommendations. This related to qualitative results that described therapist time during follow-up services fitting the equipment or training the person with the equipment at delivery, as well as in visits between full wheelchair recommendations when it was recommended to reuse the wheelchair base, but replace parts due to prolonged equipment use, or growth.

Strengths and Limitations

The mixed-methods study design provided additional detail to a complex process. The large sample size, quantitative analysis considering patient demographics, and the use of a long-standing wheelchair seating department added strength to this study.

Limitations included the descriptive quantitative study design, and as a result, the inability to determine causal relationships. The small sample sizes of the older age groups and some diagnoses resulted in the inability to perform bivariate analyses. The use of participants at only one study site limits the generalizability of these results, and artifact review as the sole qualitative data collection method limited the information gained.

Examining the dedicated wheelchair seating services through the lens of therapist documentation was both a strength and limitation. The therapist documentation primarily serves

to communicate the wheelchair user's medically justified equipment needs to the funding source. This results in valuable information on the clinical reasoning process of expert wheelchair seating therapists. However, the details of the therapist-patient discourse and patient's desires for their equipment may be underrepresented in the clinical documentation. For example, when abstracting qualitative data to determine the needs for services, it was difficult to identify the person's perceived needs for services from the therapist described needs for services. Despite this, the wheelchair user's voice was evident in the documentation; however, additional research examining the experiences of wheelchair user's in a dedicated seating department may support this study's results.

Conclusion

This study describes a consultative service delivery model for wheelchair equipment. Future research should examine the cost-effectiveness and outcomes of wheelchair users using this model versus wheelchair recommendations made within a traditional, encounter based model of therapy. Healthcare policies that support consultative, short-term models of therapy and follow-up considering extended wait times for equipment delivery may decrease barriers to receiving follow-up services. Additionally, future studies focusing on wheelchair seating and surrounding equipment should measure wheelchair quality to support the need for appropriate wheelchairs. The results obtained in this study support previous commentaries on best practice for wheelchair seating services. It has implications for physical and occupational therapists that provide wheelchair seating services, as well as health care policy.

Table 4.1
Descriptive Results of Total Sample

Variable		Count	%	Count Male	% Male
Age in 2017	0-17	194	36.2	114	58.8
	18-27	83	15.5	48	57.8
	28-64	224	41.8	132	58.9
	65-74	16	3.0	11	68.8
	75 and over	19	3.5	10	52.6
Diagnosis	ICD-10 E (Nutritional, Metabolic Disorders)	17	3.2	*	*
	ICD-10 F (Neurodevelopmental Disorders)	13	2.4	5	38.5
	ICD-10 G (Diseases of the Nervous System)	15	2.8	9	60.0
	Systemic Atrophies	19	3.5	*	*
	Other Degenerative and Demyelinating	16	3.0	7	43.8
	Myoneuronal Junction and Muscle	42	7.8	35	83.3
	CP and other Paralytic Syndromes	198	36.9	111	56.1
	ICD-10 I (Circulatory System)	11	2.1	5	45.5
	ICD-10 M (Musculoskeletal System)	8	1.5	*	*
	ICD-10 Q (Congenital Malformations)	40	7.5	20	50.0
	Spina Bifida	38	7.1	18	47.4
	TBI	36	6.7	26	72.2
	Cervical SCI	49	9.1	37	75.5
	Thoracic SCI	20	3.7	15	75.0
	Lumbar SCI and Amputations	14	2.6	8	57.1
Total Participants		536	100.0	315	58.8

Note. * indicates participant groups lower than 5, and therefore unable to be reported. "Male" category accounts for the number of males in each category; male percentages report the proportion of the number of males in the category over the total amount of people in the category. ICD-10 E (eg. diabetes mellitus, obesity). ICD-10 F (eg. Rett's syndrome, autism). ICD-10 G (eg. Huntington's Chorea, Friedrich's Ataxia, and Guillian Barre). Cerebral Palsy (CP). ICD-10 I (eg. coronary artery diseases and congestive heart failure). ICD-10 M (eg. rheumatoid arthritis and osteoarthritis). ICD-10 Q (eg. arthrogryposis and Angelman syndrome). Traumatic Brain Injury (TBI), Spinal Cord Injury (SCI).

Table 4.2
Total Number of Documents

Number of documents	Count	%
2	97	18.1
3	116	21.6
4	94	17.5
5	71	13.2
6	56	10.4
7	38	7.1
8	27	5.0
9	17	3.2
10	6	1.1
More than 10	14	2.6

Note. Percentage equals proportion of participants with *n* total documents over all participants.

Table 4.3
Average Document Count and Encounter Length by Age

Age	*Mdn(IQR)* Number of Documents	*M(SD)* Encounter Length (years)
0-17	4(3-6)	5.8(2.4)
18-27	5(3-7)	7.5(2.3)
28-64	4(3-5)	5.8(2.9)
65-74	5(4-7)	7.7(2.3)
75 +	3(2-6)	3.4(3.1)
Total	4(3-6)	6.1(2.7)

Table 4.4
Average Document Count and Encounter Length by Diagnosis

Diagnosis	*Mdn(IQR)* Number of Documents	*M(SD)* Encounter Length (years)
ICD-10 E (Nutritional, Metabolic Disorders)	3(3-5.5)	5.5(2.5)
ICD-10 F (Neurodevelopmental Disorders)	2(2-5.5)	5.2(2.8)
ICD-10 G (Diseases of the Nervous System)	4(3-5)	6.3(2.0)
Systemic Atrophies	4(2-7)	6.6(2.6)
Other Degenerative and Demyelinating	3.5(3-6)	5.3(2.4)
Myoneuronal Junction and Muscle	4(3-7)	5.6(2.6)
CP and other Paralytic Syndromes	4(3-6)	6.8(2.4)
ICD-10 I (Circulatory System)	2(2-3)	2.5(2.4)
ICD-10 M (Musculoskeletal System)	3(2-6)	4.3(3.4)
ICD-10 Q (Congenital Malformations)	4(3-6)	5.9(2.9)
Spina Bifida	4(3-5)	6.5(2.1)
TBI	5(3-6)	6.7(2.8)
Cervical SCI	5(3-6)	5.2(3.0)
Thoracic SCI	3(2-4)	4.8(3.0)
Lumbar SCI and Amputations	3(2-3)	4.3(3.5)

Note. ICD-10 E (eg. diabetes mellitus, obesity). ICD-10 F (eg. Rett's syndrome, autism). ICD-10 G (eg. Huntington's Chorea, Friedrich's Ataxia, and Guillian Barre). ICD-10 I (eg. coronary artery diseases and congestive heart failure). ICD-10 M (eg. rheumatoid arthritis and osteoarthritis). ICD-10 Q (eg. arthrogryposis and Angelman syndrome).

Table 4.5
Average Document Purpose by Age

Age	Count(%) Full Equip.	*Mdn (IQR)*	Count(%) Partial Equip.	*Mdn (IQR)*	Count(%) Services Only	*Mdn (IQR)*	Count(%) Support Previous	*Mdn (IQR)*
0-17	444(229)	2(2-2)	212(109)	1(0-2)	177(91)	0(0-1)	99(51)	0(0-1)
18-27	201(242)	2(2-3)	135(163)	1(1-2)	50(60)	0(0-1)	56(67)	0(0-1)
28-64	486(217)	2(2-2)	244(109)	2(2-2)	153(68)	0(0-1)	53(24)	0(0-0)
65-74	36(225)	2(2-3)	29(181)	2(1-2)	25(156)	1(0-2)	7(44)	0(0-1)
75 +	43(226)	2(2-3)	14(74)	0(0-1)	13(68)	0(0-1)	9(47)	0(0-1)

Note. Percentage calculated as proportion of documents per participants in the category. "Full equipment recommendations" included a wheelchair base; "partial equipment recommendations" did not. "Services only" described clinical services provided with no equipment recommendations; "supporting previous equipment" provided additional justification for equipment recommended in a previous document.

Table 4.6
Average Document Purpose by Diagnosis

Diagnosis	Count(%) Full Equip.	*Mdn (IQR)*	Count(%) Partial Equip.	*Mdn (IQR)*	Count(%) Services Only	*Mdn (IQR)*
ICD-10 E	36(212)	2(2-2)	17(100)	1(0-1.5)	11(65)	0(0-1)
ICD-10 F	29(223)	2(2-2)	13(100)	0(0-1.5)	5(38)	0(0-0)
ICD-10 G	31(207)	2(2-2)	14(93)	1(0-2)	10(67)	0(0-1)
Systemic Atrophies	50(263)	2(2-3)	20(105)	1(0-2)	14(74)	0(0-1)
Other Deg.	35(219)	2(2-2)	17(106)	1(0-2)	14(88)	1(0-1)
Myoneuronal	99(236)	2(2-3)	55(131)	1(0-3)	27(64)	0(0-1)
Cerebral Palsy	442(223)	2(2-2)	274(138)	1(1-2)	177(89)	0(0-1)
ICD-10 I	22(200)	2(2-2)	*	0(0-0)	5(45)	0(0-1)
ICD-10 M	21(263)	3(2-3)	*	0(0-1)	*	0(0-1)
ICD-10 Q	97(243)	2(2-3)	37(93)	0.5(0-1)	21(53)	0(0-1)
Spina Bifida	84(221)	2(2-2)	39(103)	1(0-1)	27(71)	1(0-1)
TBI	83(231)	2(2-3)	60(167)	1(0-3)	25(69)	0(0-1)
Cervical SCI	105(214)	2(2-2)	73(149)	1(0-2)	61(124)	0(0-2)
Thoracic SCI	44(220)	2(2-2)	6(30)	0(0-1)	11(55)	0(0-1)
Lumbar SCI	32(229)	2(2-2)	*	0(0-1)	6(43)	0(0-0)

Note. * indicates counts lower than 5, and therefore unable to be reported. Percentage calculated as proportion of documents per participants in the category. ICD-10 E (eg. diabetes mellitus, obesity). ICD-10 F (eg. Rett's syndrome, autism). ICD-10 G (eg. Huntington's Chorea, Friedrich's Ataxia, and Guillian Barre). ICD-10 I (eg. coronary artery diseases and congestive heart failure). ICD-10 M (eg. rheumatoid arthritis and osteoarthritis). ICD-10 Q (eg. arthrogryposis and Angelman syndrome). "Full equipment recommendations" included a wheelchair base; "partial equipment recommendations" did not. "Services only" described clinical services provided with no equipment recommendations.

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CHAPTER V

CONCLUSION

A series of three studies (Chapters 2-4) were performed to examine changes in clinical practice in a dedicated seating department, assess service delivery between equipment recommendations and delivery, and understand factors of dedicated seating departments that support wheelchair users when obtaining and using wheelchair seating equipment. Stanley (2015) discussed the profound changes that have occurred in the last 20 years in the coding, coverage, and payment of wheelchairs and wheelchair accessories; however, limited studies have explored healthcare system changes and access to wheelchair equipment. The numerous legislative acts and policies structuring durable medical equipment (DME) in the United States is one of many factors in the complex process of acquiring and using an appropriate wheelchair (Eggers et al., 2009; Greer, Brasure, & Wilt, 2012). This dissertation explored additional barriers and facilitators in the service delivery of wheelchair equipment. Major findings of each of the three studies, within the context of current literature, are as follows.

Trends in Wheelchair Recommendations

The first study (Chapter 2) aimed to understand how the demographics of people needing wheelchairs and the recommended wheelchairs and accessories changed over an 11-year time period. Equipment complexity for manual wheelchairs (MWCs), power mobility devices (PMDs), and cushions was defined in the structure of standard and complex equipment, as defined in currently proposed legislation, H.R. 2408. The results suggested that PMD and cushion recommendations changed the most in the time period. Potential explanations for these changes exist, both external from the national economic and healthcare sources and internal within the organization and therapists. As the majority of recommended complex PMD and cushions decreased over the time period, these results may indicate that access to complex

equipment for medically vulnerable populations (who would be more likely to need complex equipment) could be threatened. The results of this study are consistent with the results from Sprigle and Taylor's (2017) cross-sectional study examining DME claims. In both studies, complex equipment accounted for approximately 80-86% of the equipment, and complex equipment was more prevalent with younger age.

Differences in Recommended and Delivered Wheelchair Equipment

The second study (Chapter 3) utilized the wheelchair recommendations made in 2017 from the first study and matched delivery claims from two DME suppliers. Equipment, including manual wheelchairs (MWCs), PMDs, power options, cushions, and backs, were organized in complexity, similar to the first study. Significant differences in the recommended and delivered equipment were found for all equipment categories. However, gender, age, funding source, and wheelchair complexity only significantly predicted differences between MWC recommendations and delivered equipment, not PMD. The length of the process was associated with recommended PMD complexity, specifically complex PMDs with public funding sources.

This study has implications for policy and clinical practice. Previous studies have associated public funding sources with lower quality wheelchairs, higher risk of pressure ulcers, and more wheelchair repairs, with some resulting in adverse consequences (DiVita, Granger, Goldstein, Niewczyk, & Freudenheim, 2015; Groah, Ljungberg, Lichy, Oyster, & Boninger, 2014; Hogaboom, Worobey, Houlihan, Heinemann, & Boninger, 2018). This literature, along with these study results that report longer timelines for complex PMDs, suggest that people with public funding sources who need complex PMDs are at risk for either modified or cancelled equipment. This needs to be considered in the review of wheelchair policies. Also, clinical practice should incorporate follow-up visits after wheelchair delivery, as what is recommended

may not be the same as what is received, and may need modifications to fit appropriately to the person.

Frequency and Necessity of Recurring Wheelchair Visits

This study (Chapter 4) utilized participants from the first study that had two or more full wheelchair recommendations in the 11-year period. Using a mixed-methods approach, the study examined documentation to calculate the frequency and understand the reasons that people accessed the dedicated seating department. People mostly accessed the seating department for two full wheelchair evaluations; however, they also attended about one extra visit in between full wheelchair evaluations. The visits in between full wheelchair recommendations support that dedicated wheelchair seating therapists provide further support for wheelchair users than for wheelchair recommendations alone. Documentation supporting previously recommended equipment needs were also examined, with older and younger people requiring more advocating than those in the middle age group. This reveals the need for wheelchair seating clinicians to act as advocates on behalf of the wheelchair user, but also indicates that future research may be necessary to better understand the barriers that younger and older people face when getting a wheelchair. The detailed visit activities and outcomes from this study provide a comprehensive basis for clinical practice, policy, and future research in wheelchair seating, by increasing understanding of the numerous dynamic areas that are comprehensively addressed in a wheelchair seating evaluation and through equipment recommendations.

While frameworks for wheelchair service delivery have been proposed, the end goal has been to match a person with an appropriate wheelchair (Eggers et al., 2009; Greer et al., 2012). This study supported the need for follow-up, as Hansen, Tresse, and Gunnarson (2004) found, emphasizing that future wheelchair service delivery frameworks should primarily aim to support

and facilitate wheelchair users' relationships with their equipment to maximize their health and function in their daily occupations environments.

Discussion

The first two studies indicate that issues occur in all types of recommended equipment that may change the equipment that is actually delivered. However, the study results suggest threatened access of PMDs, especially complex PMDs. This is seen in the changes in the recommendations of complex to standard PMDs from 2007 to 2017. Also, there were fewer delivered PMDs in relationship to all PMDs delivered than MWCs, and more PMDs were not delivered due to insurance reasons. Patterns in cancelled or changed recommendations for PMDs was less predictable than MWCs, although the time length from recommendation to delivery was significantly related to complex PMDs, especially those with public funding sources.

However, complex PMDs provided necessary functional capabilities that help to manage medical conditions. Power options such as tilt, recline, and elevating legs assist in realigning posture, improving vision, speech and alertness, managing orthostatic hypotension, respiration, and bowel and bladder function, and redistribute and relieve pressure (RESNA, 2015). Seat elevators may improve a wheelchair user's ability to transfer independently, communicate at eye level, and reach items (Arva, Schmeler, Lange, Lipka, & Rosen, 2009; Sabari, Shea, Chen, Laurenceau, & Leung, 2016). Maintaining access to complex PMDs is important for the vulnerable population that needs them for everyday use.

Along with the issues surrounding complex PMDs, the study results showed that participants needed services in dedicated seating departments for complex equipment more than standard. Occupational and physical therapists serve as licensed/certified medical professionals that are required for complex wheelchair evaluations in Centers for Medicare and Medicaid

(CMS) wheelchair policies (CMS, 2017a, 2017b); yet, full wheelchair evaluations were not the only reason why people sought dedicated wheelchair seating department services. Support in between wheelchair evaluations resulted in recommendation of replacement parts or growth kits to extend the life of the wheelchair base, as well as training and education. This was especially true for adolescents transitioning to adulthood, and those with diagnoses of cerebral palsy, traumatic brain injury, and cervical or thoracic spinal cord injury (SCI).

Additionally, the studies supported the importance of follow-up in the service delivery of wheelchairs. The differences in recommended and delivered wheelchair equipment necessitate follow-up, to ensure that wheelchair equipment is customized to the wheelchair user, as not all equipment is delivered as recommended. Evidence of follow-up and the team approach was also noted in the qualitative results. While this is a smaller point in these studies, it is important to make, as Greer et al. (2012) reported, "…little follow-up is typically done after delivery, and formal assessments of outcomes are rare." (p. 143).

The results reveal that important factors in the service delivery of wheelchair equipment are the recommended equipment (type and complexity), and the person's age and diagnosis. Reduction in age was the only factor significantly associated with receiving a different MWC than recommended. Additionally, children and adolescents transitioning into adulthood had more documentation supporting previous equipment recommendations than the other age groups. Diagnoses groups requiring more documentation to support previous equipment recommendations included cerebral palsy, myoneuronal diagnoses (e.g.,. muscular dystrophy and myasthenia gravis), congenital malformations (ICD-10 group Q), spina bifida, and cervical SCI.

Strengths and Limitations

Strengths of this dissertation include the clinical setting as the study site, and focus of the clinicians on wheelchair seating. The retrospective nature of the study decreased bias, as the clinicians were unaware that their documentation would be utilized for research purposes in the future. Additionally, the longitudinal perspective to examine wheelchair access has not been utilized before. However, limitations exist, as one researcher reviewed the documents, abstracted and coded the data for the three studies. Additionally, the nature of two studies was descriptive, and therefore prevents causal findings. While this is a limitation, descriptive studies are necessary to guide future research. The inclusion of all ages and diagnoses of participants added information to the evidence base that, historically, focused on adults and single diagnoses. However, the geographic location of the Midwest United States and use of one dedicated seating department limits the generalizability of the results.

Future Research

This dissertation has implications for future research ideas and design, and clinical practice. More research is needed to investigate the underlying reasons for changes in recommendations of complex PMDs and cushions, which may include examining the impact of changes in healthcare policy on access to wheelchairs. Additionally, research on strategies that would simplify the approval of wheelchair equipment through funding sources may decrease the burden on clinicians and DME suppliers. This would improve the ability of healthcare organizations to support dedicated experts in wheelchair seating, and improve the wheelchair user's experience through the service delivery process.

Future research in wheelchair seating should measure wheelchair complexity. The proposed bill, H.R. 2408, that aims to protect access to complex equipment by placing it in a

separate DME category, needs evidence-based support. This can be done by incorporating wheelchair complexity into research studies, as many of the current wheelchair studies separate wheelchairs into manual and power categories. Research incorporating wheelchair complexity will also support the practice of dedicated, expert wheelchair seating therapists, as wheelchair evaluations completed in a dedicated seating department have been shown to result in recommendations for higher complexity devices (Myaskovsky et al., 2017). Overall, this will protect access and improve services for people who need wheelchairs.

Conclusion

In conclusion, this dissertation investigated factors associated access to wheelchair equipment and clinical practice in wheelchair seating. Wheelchair seating practice requires teamwork and intimate knowledge of physical attributes and their effect on a person's function. Additionally, advocacy is necessary to protect access, in clinical settings to support a person's equipment recommendations, as well as in healthcare policy to support and protect access to complex wheelchair equipment for vulnerable populations.

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Appendix A

Western Michigan University HSIRB Approval Letter

Chapter II

WESTERN MICHIGAN UNIVERSITY

Human Subjects Institutional Review Board

Date: August 22, 2017

To: Linda Shuster, Principal Investigator
Cara Masselink, Student Investigator

From: Amy Naugle, Ph.D., Chair

Re: HSIRB Project Number 17-08-14

This letter will serve as confirmation that your research project titled "Trends in Wheeled Mobility Service Provision in a Dedicated Seating Department" has been **approved** under the **exempt** category of review by the Human Subjects Institutional Review Board. The conditions and duration of this approval are specified in the Policies of Western Michigan University. You may now begin to implement the research as described in the application.

Please note: This research may **only** be conducted exactly in the form it was approved. You must seek specific board approval for any changes in this project (e.g., ***you must request a post approval change to enroll subjects beyond the number stated in your application under "Number of subjects you want to complete the study***)." Failure to obtain approval for changes will result in a protocol deviation. In addition, if there are any unanticipated adverse reactions or unanticipated events associated with the conduct of this research, you should immediately suspend the project and contact the Chair of the HSIRB for consultation.

Reapproval of the project is required if it extends beyond the termination date stated below.

The Board wishes you success in the pursuit of your research goals.

Approval Termination: **August 21, 2018**

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Appendix B

Mary Free Bed Rehabilitation Hospital HSIRB Approval Letter

Chapter II

Restoring Hope and Freedom
Mary Free Bed Rehabilitation Hospital 800.528.8989 • www.maryfreebed.com • 235 Wealthy SE • Grand Rapids, MI 49503

TO: Cara Masselink
RE: Notice of approval from the Research Institutional Review Board
Title: Trends in wheeled mobility service provision in a dedicated seating department
MFB #: 2017.12

APPROVAL DATE: September 13, 2017
EXPIRATION DATE: August 21, 2018

Your 09/05/2017 submission of the project identified above has received an expedited review based on criteria outlined under "Expedited Review Policy" of the Research Institutional Review Board at Mary Free Bed Rehabilitation Hospital and Category 4 of CFR 45 Part 46.116. Your request for this retrospective analysis study is hereby *approved*.

The following documents were reviewed:

- MFB IRB application
- Detailed study proposal
- Western Michigan University IRB approval letter of 08/22/2017

My only reservation about your study is what appears to be some confusion about the statistical analyses. You stated that the purpose of your study would be "to identify differences in wheelchair recommendations by diagnosis, funding source, age, gender, and race/ethnicity". However, later in the proposal, you referred to wheelchair type as an "independent variable", which is incongruent with your stated purpose. I also noted that there were numerous levels of your categorical variables, which can be problematic in logistic regression. I strongly advise you to follow up on these issues with your WMU academic advisor. However, in light of the fact that your university has allowed you to proceed, I will not stand in the way of you pursuing this study. You just need to realize that failure to resolve these issues may compromise the conclusions that you can draw from your planned analyses.

For this decision, I took into consideration the adequacy of the protection of the privacy of the data of the participants involved. Please note the expiration date for this approval. I set it equivalent to the date that WMU's IRB had specified. You must apply for re-approval if the research is to continue beyond the expiration date.

Thank you for your cooperation with the Research IRB. If you have any questions on the above information, please contact me via email (jacobus.donders@maryfreebed.com) or at 616.840.8162.

Sincerely,

Jacobus Donders, PhD
Interim Chair - Research Institutional Review Board

Appendix C

Western Michigan University HSIRB Approval Letter

Chapter III

WESTERN MICHIGAN UNIVERSITY

Institutional Review Board
FWA00007042
IRB00000254

Date: March 12, 2019

To: Linda Shuster, Principal Investigator
Cara Masselink, Student Investigator for dissertation
Victoria Vaughan, Student Investigator

From: Amy Naugle, Ph.D., Chair

Re: IRB Project Number 19-03-07

This letter will serve as confirmation that your research project titled "Differences in Recommended and Delivered Wheelchair Equipment" has been **approved** under the **exempt** category of review by the Western Michigan University Institutional Review Board (IRB). The conditions and duration of this approval are specified in the policies of Western Michigan University. You may now begin to implement the research as described in the application.

Please note: This research may **only** be conducted exactly in the form it was approved. You must seek specific board approval for any changes to this project (e.g., ***add an investigator, increase number of subjects beyond the number stated in your application, etc.***). Failure to obtain approval for changes will result in a protocol deviation.

In addition, if there are any unanticipated adverse reactions or unanticipated events associated with the conduct of this research, you should immediately suspend the project and contact the Chair of the IRB for consultation.

The Board wishes you success in the pursuit of your research goals.

A status report is required on or prior to (no more than 30 days) March 11, 2020 and each year thereafter until closing of the study. The IRB will send a request.

When this study closes, submit the required Final Report found at https://wmich.edu/research/forms.

Note: All research data must be kept in a secure location on the WMU campus for at least three (3) years after the study closes.

Office of the Vice President for Research
Research Compliance Office
1903 W. Michigan Ave., Kalamazoo, MI 49008-5456
PHONE: (269) 387-8293 FAX: (269) 387-8276
WEBSITE: wmich.edu/research/compliance/hsirb

CAMPUS SITE: Room 251 W. Walwood Hall

Appendix D

Mary Free Bed Rehabilitation Hospital HSIRB Approval Letter

Chapter III

Restoring Hope and Freedom
Mary Free Bed Rehabilitation Hospital 800.528.8989 • www.maryfreebed.com • 235 Wealthy SE • Grand Rapids, MI 49503

TO: Linda Shuster, PhD
Cara Masselink, MS
RE: Notice of approval from the Research Institutional Review Board
Title: Differences in recommended and delivered wheelchair equipment
MFB #: 2019.11

APPROVAL DATE: May 30, 2019
EXPIRATION DATE: March 11, 2020

Your 05/24/2019 submission of the project identified above has received an expedited review based on criteria outlined under "Expedited Review Policy" of the Research Institutional Review Board at Mary Free Bed Rehabilitation Hospital. Your request for this retrospective analysis of a limited dataset is hereby *approved*. The request for a waiver of consent is granted.

The following documents were reviewed:
- MFB IRB application
- Detailed study proposal
- MFB Research department approval letter (05/15/2019)
- Support letter from manager (Scholtens; 02/04/2019)
- Business associate agreement (05/14/2019)
- Data use agreement (05/14/2019)
- Letter of commitment from Airway Oxygen (02/27/2019)
- Letter of commitment from CareLinc Medical (02/27/2019)
- WMU IRB approval letter (03/12/2019)

For this decision, the following were taken into consideration:
1. The adequacy of the protection of the rights and welfare of the participants involved.
2. The risks and potential benefits to the participants in relation to the importance of the knowledge gained.

As the Principle Investigator for this study, you have the following obligations:
1. To report all serious and unexpected adverse events to the Research IRB within 5 working days.
2. To obtain approval from the Research Institutional Review Board before instituting any change in the protocol.
3. Please note the expiration date for this approval. I have set this to the same date specified by WMU's IRB. You must apply for re-approval if the research is to continue beyond the expiration date.

Thank you for your cooperation with the Research IRB. If you have any questions on the above information, please contact me via email (jacobus.donders@maryfreebed.com) or at 616.840.8162.

Sincerely,

Jacobus Donders, PhD
Interim Chair - Research Institutional Review Board

Appendix E

Western Michigan University HSIRB Approval Letter

Chapter IV

WESTERN MICHIGAN UNIVERSITY

Institutional Review Board
FWA00007042
IRB00000254

Date: February 19, 2019

To: Linda Shuster, Principal Investigator
Cara Masselink, Student Investigator for dissertation
Victoria Vaugh, Student Investigator

From: Amy Naugle, Ph.D., Chair

Re: IRB Project Number 19-02-48

This letter will serve as confirmation that your research project titled "Frequency and Necessity of Recurring Wheelchair Visits" has been **approved** under the **exempt** category of review by the Western Michigan University Institutional Review Board (IRB). The conditions and duration of this approval are specified in the policies of Western Michigan University. You may now begin to implement the research as described in the application.

Please note: This research may **only** be conducted exactly in the form it was approved. You must seek specific board approval for any changes to this project (e.g., ***add an investigator, increase number of subjects beyond the number stated in your application, etc.***). Failure to obtain approval for changes will result in a protocol deviation.

In addition, if there are any unanticipated adverse reactions or unanticipated events associated with the conduct of this research, you should immediately suspend the project and contact the Chair of the IRB for consultation.

The Board wishes you success in the pursuit of your research goals.

A status report is required on or prior to (no more than 30 days) February 18, 2020 and each year thereafter until closing of the study. IRB will send a reminder.

When this study closes, submit the required Final Report found at https://wmich.edu/research/forms.

Note: All research data must be kept in a secure location on the WMU campus for at least three (3) years after the study closes.

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Appendix F

Mary Free Bed Rehabilitation Hospital HSIRB Approval Letter

Chapter IV

Restoring Hope and Freedom
Mary Free Bed Rehabilitation Hospital 800.528.8989 • www.maryfreebed.com • 235 Wealthy SE • Grand Rapids, MI 49503

TO: Cara Masselink, MS
RE: Notice of approval from the Research Institutional Review Board
Title: Frequency and necessity of recurring wheelchair visits
MFB #: 2019.08

APPROVAL DATE: March 24, 2019
EXPIRATION DATE: February 18, 2020

Your 02/21/2019 submission of the project identified above has received an expedited review based on criteria outlined under "Expedited Review Policy" of the Research Institutional Review Board at Mary Free Bed Rehabilitation Hospital. Your request for this no more than minimum risk study is hereby ***approved***.

The following documents were reviewed:

- MFB IRB application
- External research checklist
- Detailed study proposal
- Letter (02/04/2019) and e-mail (02/23/2019) from MFB sponsor Matthew Scholtens
- WMU IRB approval letter of 02/19/2019
- Data use agreement of 03/01/2019

For this decision, the following were taken into consideration:

1. The adequacy of the protection of the rights and welfare of the participants involved.
2. The risks and potential benefits to the participants in relation to the importance of the knowledge gained.

As the Principle Investigator for this study, you have the following obligations:

1. To report all serious and unexpected adverse events to the Research IRB within 5 working days.
2. To obtain approval from the Research Institutional Review Board before instituting any change in the protocol.
3. Please note the expiration date for this approval. I set this to the same date as specified in the WMU IRB letter. You must apply for re-approval if the research is to continue beyond the expiration date.

Thank you for your cooperation with the Research IRB. If you have any questions on the above information, please contact me via email (jacobus.donders@maryfreebed.com) or at 616.840.8162.

Sincerely,

Jacobus Donders, PhD
Interim Chair - Research Institutional Review Board