

EFFECTIVENESS OF THE VA SYSTEM AT PROVIDING
WHEELED MOBILITY DEVICES

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Abstract: A plethora of data has been collected documenting the need for assistive technology. There is little information however about the efficacy, distribution, and impact of assistive technology. Three related studies investigating demographic, cost, and health related quality of life (HRQoL) factors of the provision of wheelchairs and scooters were completed. The first investigated demographic and clinical differences. The second investigated differences in wheelchair costs among Veteran Integrated Service Networks (VISNS) and vendors. The third investigated the relationship between wheelchairs provided by the Veterans Health Administration (VHA) and HRQoL. Using a cross-sectional, retrospective study design, three years of data from VHA National Prosthetic Patient and National Patient Care yielding 191,324 observations. Databases, and one year of data from the SF-36V of the Veterans Health Study were merged. Descriptive statistics, t-test, chi-square, ANCOVA, ANOVA, and logistic regression were used to analyze the data. The first study found more evidence for differences between Hispanics and Caucasians than between African Americans and Caucasians. When comparing manual wheelchairs, Hispanics (Odds Ratio=1.7), African Americans (Odds Ratio =1.1), and American Indians & Asians (Odds Ratio =1.6) were more likely than Caucasians to receive depot wheelchairs, and Hispanics were more likely than Caucasians to receive ultralight chairs (Odds Ratio=1.8). When comparing power wheelchairs Hispanics (Odds Ratio=1.6) were more likely than Caucasians to receive

custom power chairs. Older veterans were more likely to receive standard depot wheelchairs ($p < .0001$) and younger veterans ultralight wheelchairs ($p < .0001$). The most frequently prescribed wheelchairs for all diagnoses were the standard manual wheelchair (51%), the lightweight manual wheelchair (15%), and the scooter (14%). The second study found variation in cost by VISN and by vendor. During FY00 and FY01, of the \$109 million spent by the VHA to provide over 131,000 wheelchairs and scooters, 7%, or \$7,747,405 was considered excessive cost. The third study found veterans who received adjustable, ultralight manual wheelchairs had significantly lower physical function scores, as measured by the SF-36V, and significantly higher mental function, general health, and mental component summary scores than veterans who received nonadjustable, standard manual chairs, when adjusting for clinical and demographic factors.

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1 CHAPTER ONE

1.1 INTRODUCTION

Too many Americans with disabilities remain outside the economic and social mainstream, lacking the necessary tools and access for full participation in society [1, 2]. Fortunately, individuals with disabilities are demanding to be treated as competent citizens, with their capabilities recognized, and their civil rights fulfilled (Susan McDaniels, PhD, former Deputy Commissioner for Disability and Income Security, oral communication, December, 2001). The Disability Rights Movement, the most recent civil rights initiative, views disability as a product of interaction between humans and their surroundings, shifting the emphasis from the individual with an impairment to the broader, social, cultural, economic, and political environments. Implied is that disability stems from the failure of a structured social environment to adjust to the needs and aspirations of individuals with impairments, rather than from the inability of individuals with disabilities to adapt to the demands of society [3].

The Disability Rights Movement, spawned in the 1970s, has chipped away at the stigma with which society views individuals with disabilities [4, 5], resulting in change in societal attitudes. Advent of the microcomputer chip during the 1970s has also elicited change. Advances in technology are providing new options for individuals with disabilities as well as making environments more accessible. Technology designed to be utilized in assistive technology devices or services is referred to as assistive technology (AT) [6].

“The term assistive technology (AT) means technology designed to be utilized in an assistive technology device or assistive technology service. The term AT device means any item, piece of equipment, or product system, whether acquired commercially, modified, or customized, that is used to increase, maintain, or improve functional capabilities of individuals with disabilities. The term AT service means any service that directly assists an individual with a disability in the selection, acquisition, or use of an assistive technology device. The term universal design means a concept or philosophy for designing and delivering products and services that are usable by people with the widest possible range of functional capabilities, which include products and services that are directly usable (without requiring assistive technologies) and products and services that are made usable with assistive technologies” [6].

AT can range from simple, low technological devices such as reachers to highly technical electronic equipment such as augmentative and alternative communication devices and specialized power wheelchairs. As the terms would imply, low technologies do not require mobilization of many financial and human resources. These devices tend to be less expensive, simple to make, and easy to obtain. Low technology solutions can be implemented faster, are easier to learn, and usually more cost effective. Examples of low

technology include communication boards, raised toilet seats, bath benches, rocker knives, letter boards, hand signals, eye signals, lip reading, and eye blink charts [7-9].

High technologies evolved from biomedical and rehabilitation engineering. These technologies require major capital investments and mobilization of greater human, physical, and administrative resources. High technology devices are often expensive, require commercial manufacturing, and are harder to obtain [7]. Because high technology devices are mediated by electronic circuits and microprocessors, they may not always be under the direct control of the user. They tend to be more difficult to learn how to use, require configuration, and usually need to be sent away for repairs. Examples of high technology include environmental control units, cochlear implants, on-screen keyboards, text-to-speech software, voice synthesizers [9, 10], alternative and augmentative communication devices [11, 12], and power stair climbing wheelchairs [13].

The focus of this dissertation research is on just one aspect of AT, wheeled mobility devices, specifically wheelchairs and scooters. The wheel and chair were man's two earliest inventions, dating back to 4000B.C. [14]. Paintings of Philip II of Spain are perhaps the earliest graphic representations of a wheelchair. The wheelchair used by Philip II, who had gout, was built by Jehan L. Hermite, who wrote in his memoirs "Though it was but of wood, leather, and ordinary iron [it] was worth ten times its weight in gold and silver for his Majesty's comfort" [15].

In 1919, a mining engineer, Herbert A. Everest, broke his back in a mining



Figure 1 Everest and Jennings Wheelchair

accident, losing the use of his legs. Dissatisfied with his large, wooden chair, and wanting one that could be stowed in an automobile, Everest, with the help of a friend, Harry Jennings, a mechanical engineer, created and patented a wheelchair that was easily transported and practical to use (Figure 2) [16, 17].

This sling upholstery, chrome plated, steel folding X-frame design is still in use today (Figure 1).

A 1924 advertisement for an “electric wheelchair for invalids with all the luxuries of an auto” [18] resembles the scooters of today (Figure 3).

“Chairs with wheels” have been used for



Figure 3 Early Scooter

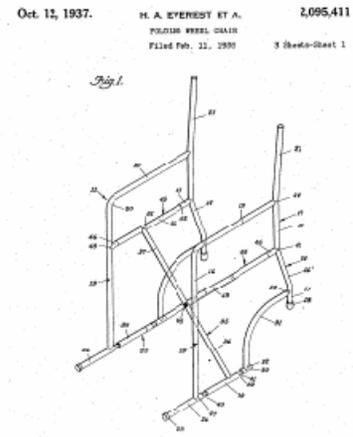


Figure 2 Everest and Jennings Patent

centuries to provide mobility for individuals for whom the task of walking is difficult or impossible, due to impairments of their lower extremities. Not only have wheelchairs provided mobility, they

have made the physical environment more accessible. Advances in technology have produced devices that function indoors, outdoors, can climb curbs, and elevate to a standing position (Figure 4). Modern wheelchairs are light enough to be folded and lifted into a vehicle by the user, and can be used for sports such as basketball and rugby. In turn, theaters, buses, schools, and places of employment are increasingly more able to accommodate these more versatile wheelchairs.



Figure 4 Wheelchair with seat elevation option

Providing mobility and alleviating physical barriers are obvious benefits of wheeled mobility use.

Less obvious are the contributions wheelchair and scooter designs have contributed to framing the concept of universal design and alleviating stigma. The curb cut was designed to increase accessibility for wheelchair users. Soon bicyclists and people with strollers, shopping carts, or rolling luggage began using the curb cuts as well. Sidewalks with curb cuts were simply better sidewalks for everyone [19]. The curb cut concept has since been extended to the “Electronic Curb-Cut Effect” [19], a metaphor for electronic accessibility mandated by the Section 508 addendum to the Rehabilitation Act [20], and curb cut learning, a barrier free design approach to distant learning [21]. The term universal design, coined by Ronald L Mace in 1988, is defined as “the design of products and environments to be usable by all people, to the greatest extent possible, without the need for adaptation or specialized design” [22]. The goal of universal design is to integrate people with disabilities into the mainstream, whereas AT is more directed at

meeting the specific needs of individuals [22]. What universal design and AT have in common is they both reduce the physical and attitudinal barriers between people with and without disabilities.

In addition to providing mobility and environmental access, advances in wheeled mobility technology and design have contributed decreasing the stigma associated with wheelchair use. Three-wheeled scooters, more socially acceptable than wheelchairs, are now widely used by senior citizens. As wheeled mobility devices are increasingly more visible and customary, a cycle is created where non-disabled individuals become more accustomed to interacting with individuals who use wheeled mobility devices. This interaction in turn increases environmental accommodation and access, which further increases visibility.

Concurrently with the increasing demand for wheeled mobility, is tightening of the purse strings to control health care costs that have soared since the implementation of Medicare in the 1960s. In addition, policy has not been adequately updated to systematically determine who should get which and how many wheeled mobility devices [23]. The purpose of this research was to investigate the outcomes of the wheelchair provision process: how many wheeled mobility devices are being provided? To whom? And at what cost? The long-range goal of this research topic is to measure the impact of these “chairs with wheels” documented pictorially, anecdotally, and by “self-evident benefits” [24] through the centuries.

This dissertation is comprised of three related studies:

- Demographic Characteristics of Veterans Receiving Wheelchairs and Scooters from the Veterans Health Administration
- Veterans Health Administration Costs in Providing Wheeled Mobility Devices
- Relationship Between Type of Wheelchair and Health Related Quality of Life.

The research design for all three studies was retrospective and spanned the Federal fiscal years 1999, 2000, 2001. Three Veterans Health Administration (VHA) databases [25], the National Prosthetic Patient Database (NPPD), the National Patient Care Database (NPCD), and the SF-36V of the Veterans Health Study (VHS) [26], were merged to investigate the demographic characteristics of veterans who received wheelchairs and scooters from the VHA, the cost incurred by the VHA for these devices, and the relationship between health related quality of life (HRQoL) and receipt of a wheeled mobility device from the VHA.

The primary database was the NPPD developed by the VHA Prosthetic and Sensory Aids Service (PSAS) [25, 27] to monitor the provision of



Figure 5 Depot wheelchair



Figure 6 Ultra light wheelchair

orthotic, prosthetic, and sensory devices to eligible veterans. Records of veterans who received wheelchairs and scooters from the VHA during the study years were extracted from the NPPD. This NPPD data was then merged, by scrambled patient identification numbers, with the NPCD and the SF-36V data of the VHS to obtain demographic, clinical, and HRQoL information on veterans who received wheelchairs and/or scooters from the VHA during FY99, FY00, and FY01. This data set comprised the sample for this study.

Prior studies of the relationship between demographics and AT, including wheelchair use [28-30], have looked at whether the individual used a wheelchair, with no differentiation made between types of wheelchair, i.e. manual versus power. Other studies have compared the durability of types of wheelchairs, i.e. depot, (Figure 5) lightweight, ultralight, (Figure 6) and power wheelchairs [31-35]. Only one study [36], in press, was found that compared type of wheelchair with demographic, and no studies were found that compared type of wheelchair with cost or HRQoL. The first study categorized wheelchairs into eight types: four types of manual wheelchairs, three types of power wheelchairs and scooters (Table 1). These categories comprised the dependent variable (DV) for the analysis of all but one of the hypotheses in this dissertation research (type of wheelchair was the independent variable (IV) in the first HRQoL hypothesis).

Table 1 Operational definitions: wheelchair type

Code	Type of Wheelchair	Description
K0001 = manual wc depot	M1	> 36 lbs, non-adjustable; “depot” wheelchair
K0002 = manual wc hemiplegia		> 36 lbs, non-adjustable, lower seat only; depot wheelchair
K0003 = manual wc lightweight		≤ 36 lbs, non-adjustable; lightweight, depot wheelchair
K0004 = manual wc lightweight	M2	<34 lbs., adjustable seat/back height, some adjustment in axle; high strength, lightweight; rehabilitation wheelchair
K0005 = manual wc ultralight	M3	< 30 lbs., adjustable seat/back height/axle/camber; ultralight wheelchair
K0006-7 = manual wc heavy duty	M4	Miscellaneous manual wheelchairs
K0009 = manual wc other		
K0010 = power wc	P1	non-adjustable, seat height only, standard weight non-programmable controls
K0011 = power wc	P2	Miscellaneous power wheelchairs
K0012 = power wc		
K0014 = power wc	P3	custom power wheelchairs, other motorized wheelchair base
E1230 = scooter	S1	scooter

1.3.1 Demographic Characteristics of Veterans Receiving Wheelchairs and Scooters from the Veterans Health Administration

Use of AT has increased dramatically over the past two decades. Influencing factors include the aging of the population, advances in technology, public policy initiatives, and changes in the delivery and financing of health care [37, 38]. In fact, use of AT has increased while reliance on personal assistance by individuals with disabilities has decreased [39]. For example, use of power mobility has been shown to increase individual’s ability to fulfill life roles [40]. During the 10 year period from 1990 to 2000, individuals with disabilities have become more aware of AT and how AT can affect independence, productivity, and community integration [41]. AT has been shown to decrease the rate of functional decline of elders [42] and elicit improvement in function of individuals with developmental disabilities [43].

The prevalence of mobility limitations has risen by over 10 million in 10 years [44]. Of the 49.7 million people identified by the 2000 U.S. census as having a disability, approximately 18 million reported mobility limitations, and 2.2 million reported using a wheelchair [45]. More people use AT to compensate for mobility impairment, i.e. wheeled mobility devices, than any other general type of impairment [38, 46].

As the availability of and demand for wheeled mobility devices increases, two factors emerge: policy must be put in place to allocate the devices, and clinicians must be kept abreast of this rapidly changing field if they are to meet the needs of their clients and the fiscal scrutiny of their employers. The NPPD offers a unique opportunity to study wheeled mobility outcomes. Only one published study of the NPPD [47] was found, a study comparing VHA and Medicare AT expenditures. Thus the purpose of the first study of this dissertation research was to examine demographic and clinical outcomes of the provision of wheeled mobility devices provided by the VHA.

This study had two objectives. The first was to provide a description of NPPD data, asking questions such as how many wheeled mobility devices were provided and what were the most frequent diagnoses and demographic and clinical characteristics of the veterans who received these devices. The second objective introduced the concept of wheelchair type and tested the significance of differences in demographic and clinical characteristics in relation to type of wheelchair provided. The IVs for this study were the demographic variables (age, gender, and race/ethnicity) controlling for diagnosis and number of comorbidities. The significance of this study was to provide demographic and clinical outcomes information on the provision of wheeled mobility devices by the VHA

for the purposes of improving the consistency in and quality of care of veterans, and to assist in developing PSAS policy guidelines.

1.3.2 Cost of Wheeled Mobility Devices to the Veterans Health Administration

The next step in this dissertation research was to look at the cost of providing wheeled mobility devices. A VHA preliminary report on the top total dollar cost prosthetic items (Fred Downs, Chief Consultant, PSAS, written communication, December, 2000) indicated for the first three quarters of 2000, scooters were the second highest spending total, manual wheelchairs the third highest spending total, and power wheelchairs the fifth, (oxygen equipment was the first). For these three quarters, over 40,000 wheelchairs (manual wheelchairs, power wheelchairs, and scooters), were provided at a government cost of over 20 million dollars. Similarly, wheelchairs are the most frequently reimbursed durable medical equipment (DME) by Medicare [48, 49]. Render et. al concluded that the VHA spends less providing prosthetic devices than Medicare [47], possibly because the VHA purchases and dispenses the devices. Yet, the VHA is seeking to improve their provision system [27], (Fred Downs, Chief Consultant, PSAS, written communication, January and December, 2000) to reduce cost and improve the quality of care provided to veterans. In addition, cost outcomes data can help identify opportunities for consolidated contracting of wheeled mobility devices.

The second study also had two objectives. The first was to examine cost differences among regional areas; the IV was geographical area as defined by the Veteran Integrated Service Network (VISN) [50]. The second objective was to determine whether variance in wheelchair and scooter cost by vendor exists; the IV was vendor. The VISN and vendor analyses were done for each wheelchair, using Health Care Common

Procedure Coding System (HCPCS) codes rather than by wheelchair type categories. In order to be reimbursed by Medicare, the VHA, and most other insurers, wheelchairs and scooters sold in the U.S. must be approved as devices by the U.S. Food and Drug Administration (FDA) [51]. The FDA then forwards application information to the Center for Medicare and Medicaid HCPCS code, developed for reimbursement purposes. The NPPD also uses HCPCS codes, as a means of tracking wheelchairs. Thus the significance of this study was to determine whether variance in cost exists regionally or by vendor, and if so to identify and describe high cost outliers by VISN and by vendor, as a method of assessing the efficiency of the VHA system of providing wheeled mobility devices.

1.3.3 Relationship Between Type of Wheelchair and Health Related Quality of Life

The NPPD is an administrative database. One of the limitations of administrative databases is they do not provide patient specific outcomes [52]. The third study in this dissertation research linked NPPD administrative data with patient specific HRQoL VHS data. The significance of this study was to lay a foundation for future studies quantifying the impact of the “chairs with wheels” that have only thus far been documented pictorially, anecdotally, and with self-evidence [24] (the long-range goal of this research).

The benefits of AT have eluded researchers for years [53, 54]. While AT outcomes are important “to facilitate marketing decisions, enhance accountability, and not least of all, augment our knowledge base”[24], there is a paucity of appropriate outcome measures [24, 53, 54]. AT outcomes research is needed to provide information for consumers, to establish a cost-benefit ratio, to provide reliable and valid measurement instruments, and increase the understanding of device abandonment [55]. Wheeled

mobility devices are of the few AT devices that have to provide a benefit before they will be reimbursed [24, 51].

Three national research centers have been established to increase the understanding of the effect of AT [56]. In 1991, the National Institute on Disability and Rehabilitation Research (NIDRR) funded two 5-year projects to advance AT outcomes measurement [55, 57], and the Office of Special Education Programs funded the National Assistive Technology Institute [58], targeting the school-age population. Within the VHA, the lack of functional outcomes has been reported by the Chief Consultant of the PSAS (Fred Downs, Chief Consultant, PSAS, written communication, December, 2000).

The third study merged the NPPD with the SF-36V data from the Veterans Health Study (VHS) [26, 59] to investigate the relationship between wheeled mobility devices and veteran specific health related quality of life (HRQoL). The SF-36V is a patient-derived measure of health status consisting of eight scales and two summary scores [59-61] used to characterize the case-mix of the VHA clientele as a baseline for future studies.

This study also had two objectives. The first was to investigate the effect of adjustability of wheelchairs on social participation; type of wheelchair was the IV and social participation the DV. The second objective was to investigate whether health need (HN), as measured by the SF-36V, predicted the type of wheelchair prescribed; HN was the IV and type of wheelchair the DV. The most elusive (in interpretation of data) of the three studies, due to the complexity of relating assistive technology outcomes to individuals with disabilities [24, 53, 54], this study would provide at least pilot data for

further studies on the impact of wheeled mobility devices on the individual lives of the users.

Separate analyses were performed for manual and for power wheelchairs for analysis of all hypotheses. An alpha level of 0.05 was used to determine significance when testing the hypothesis. An alpha level of 0.10 was used when comparing groups for baseline differences during univariate analyses. SAS® Version 8.2 was used for all analyses. The appendices of this dissertation contain the SAS® programs written to analyze the data. A table of abbreviations used in this study is provided (Table 2).

Table 2 Abbreviations/acronyms:

Abbreviation	Description
AAC	Austin Automation Center
ADL	Activities of daily living, i.e. dressing, bathing
ALS	Amyotrophic lateral sclerosis
AT	Assistive technology
ATDS	Assistive technology devices
ATS	Assistive technology specialist
BP	Bodily Pain (SF-36V)
COPD/CHF	Chronic obstructive pulmonary disorder/chronic heart failure
CMS	Center for Medicare and Medicaid Services
CV	Confounding variable
DV	Dependent variable
DME	Durable Medical Equipment
FBI	Federal Bureau of Investigation
FDA	Food and Drug Administration
FIM	Functional Independence Measure
FSOD	Functional Status Outcomes Database

Table 2 Abbreviations/acronyms:

Abbreviation	Description
FY	Fiscal year
GH	General health (SF-36V)
HCPCS	Healthcare common procedure coding system
HS	Health status
HIPAA	Health Insurance Portability and Accountability Act of 1996
HRQoL	Health related quality of life
ICD-9	International classification of disease-revision 9
ICF	International classification of function
IV	Independent variable
MCS	Mental Component Summary Score of SF-36V
MH	Mental health (SF-36V)
MOS	Medical outcome study
MS	Multiple sclerosis
NHIS-D	National Health Interview Survey on Disability
NPCD	National Patient Care Database
NPPD	National Prosthetics Patient Database
NSC/IP	Service connected, inpatient
NSC/OP	Service connected, outpatient
NLTCS	National Long Term Care Survey
OR	Odds ratio
PCS	Physical Component Summary Score of SF-36V
PD	Parkinson disease
PH	Physical health (SF-36V)
POW	Prisoner of war
PSAS	Prosthetics and Sensory Aids Services
RE	Role limitation due to physical problems (SF-36V)

Table 2 Abbreviations/acronyms:

Abbreviation	Description
RESNA	Rehabilitation Engineering & Assistive Technology Society of North America
RP	Role limitation due to emotional problems (SF-36V)
SCI	Spinal cord injury
SCIP	Spinal cord injury-paraplegia
SC/IP	Service connected, inpatient
SCIT	Spinal cord injury-tetraplegia
SC/OP	Service connected, outpatient
SF	Social functioning (SF-36V)
SF-36V	Short form 36 item health survey for veterans
TBI	Traumatic brain injury
VACO	Veterans Administration Central Offices
VAMC	Veterans Affairs Medical Center, facility
VHA (VA)	Veterans Health Administration
VHS	Veterans Health Study
VISN	Veterans Integrated Service Network
VIReC	VA Information Resource Center
VT	Vitality (SF-36V)
WHO	World Health Organization
WMD	Wheeled mobility device, i.e. wheelchair or scooter

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2 CHAPTER TWO

WHEELCHAIRS AND DEMOGRAPHIC CHARACTERISTICS

Demographic Characteristics of Veterans Receiving Wheelchairs and Scooters from the Veterans Health Administration

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2.1 Abstract

The purpose of this study was to characterize veterans who received wheelchairs and scooters from the Veterans Health Administration (VHA) and to determine if differences in the provision of wheelchairs, based on gender, race/ethnicity, diagnosis, and age, exist. Using a retrospective study design, three years of data from two VHA databases, the National Prosthetic Patient Database (NPPD) and the National Patient Care Database (NPCD) were merged yielding of over 77,000 observations per fiscal year. Wheelchairs and scooters were categorized into eight types based on function, adjustability and Medicare codes. Descriptive statistics were used to characterize veteran participants. Chi-square and ANOVA univariate analyses and logistic regression were used to quantify the association between provision of wheeled mobility devices and age, gender, and race/ethnicity, controlling for diagnosis and number of comorbidities. Differences were more evident between Hispanics and Caucasians than between African Americans and Caucasians. The results indicated Hispanics (Odds Ratio=1.9), African Americans (Odds Ratio=1.4), Asians and American Indians (Odds Ratio=1.6) were more likely than Caucasians to receive standard wheelchairs. Hispanics (Odds Ratio=0.8) and African Americans (Odds Ratio=0.9) were less likely than Caucasians to receive power wheelchairs. Hispanics (Odds Ratio=0.4), African Americans (Odds Ratio=0.7), Asians and American Indians (Odds Ratio=0.4) were less likely than Caucasians to receive scooters. The most frequently prescribed manual wheelchair was the standard, depot wheelchair (66%) compared to the ultralight wheelchair (4%), and the lightweight rehabilitation wheelchair 20%

2.2 Introduction

Though data on disability and assistive technology devices (ATDS) has been gathered [1-3] from the National Health Interview Survey on Disability (NHIS-D), the National Long Term Care Survey (NLTC) [4], and other studies [5, 6], there remains a paucity of in depth information on how many devices are provided, by whom, and to whom. As of September of 2002, there were over 25 million veterans [7]; more than two million (8%) of these veterans have been classified by the Veterans Health Administration (VHA) as having a disability [7]. Approximately 15% of the veteran population receives their health care from the VHA [7]. No published information on how many veterans use wheelchairs and scooters is currently available. The National Patient Prosthetics Database (NPPD), designed to collect data on the provision of wheeled mobility devices in order to improve the quality of care for veterans [8, 9], was implemented in 1997 and made available to researchers in 1999.

Little is known about the decision process in which clinicians engage when prescribing a wheeled mobility device. Equally unknown is the outcome of this decision process, i.e. how many devices are being prescribed and to whom? how often? at what cost? While several studies have found demographic variance in the provision of ATDS (including wheelchairs) in the non-veteran population [2, 5, 10, 11], no studies were found that addressed the provision of wheelchairs or the even broader topic of assistive technology (AT) in general within the veteran population.

Several studies have examined the relationship between the use of AT and age, gender, race, chronic disease, income, and/or education in the non-veteran population. The majority of persons using ATDS are over 65 years of age [10]. Using NHIS-D data,

Kaye et al.[2] found more women (58.8%) use wheeled mobility devices than men.

Tomika et al. [5] found African American elderly, when compared to Caucasian elderly, used significantly less ATDS designed for vision impairment, with no significant difference in the use of mobility devices. In the same study, Tomika et al. found living alone and a higher number of illnesses predicted AT use for African American elders, whereas higher cognitive status, higher income, increased disability, and age (for every 10 years of aging, elders used 2.64 less devices, mean age ~ 73) predicted ATD use for Caucasian elders. Using data from the Canadian Aging Research Network collected in 1991-1992 (with questions similar to the U.S. 1984 NHIS study) Zimmer and colleagues [6] found rural, older elders (mean age=78) with more chronic conditions and more mobility difficulties tended to use ATDS more often. Each year of age increased chances of device use by 1.04. Each chronic condition increased chances of device use by 1.18, and each additional mobility problem increased chances of device use by 2.47. The contrast between Tomika et al.'s finding that increasing age decreased device use and Zimmer et al.'s finding that increasing age increased device used may be attributed to the way the dependent variable, device use, was measured. Tomika et al. counted devices owned and used whereas Zimmer et al. counted the tasks for which devices were used.

Like Zimmer et al., Rubin et al. [11], using 1994 NLTCS data, also found AT use by the elderly to vary by nature of chronic disease. However, in contrast to Tomika et al., Rubin et al. found device use to vary according to race: elderly African Americans were two to 20 times more likely to use some types of AT than Caucasians. There was no significant difference however, between African Americans and Caucasians in their use of wheelchairs. Rubin et al. also found Caucasians reported using devices requiring home

modification whereas African Americans reported using portable devices. In addition, African Americans who used AT tended to be older; Caucasian users tended to be female, with more education. Kaye et al. [2] found wheelchair use to be highest for Native Americans (0.81%), then Caucasians (0.63%), then African Americans (0.56%), then Hispanics (0.36%).

In summary, relationships between AT use and age, gender, race, chronic disease, income, and/or education have been found. Number of chronic conditions predicts AT use for African Americans and Caucasians [5, 6, 11]; device users are more likely to live alone [5] and to be female [2, 11]. African Americans users are more likely to be older [11], Caucasian device users are more likely have a higher education [11], higher cognitive status, and higher income [5]. While there was variance between African Americans and Caucasians in the use of some ATDS, variance was not apparent for the use of wheelchairs [5, 11]. Low-tech mobility devices (i.e. canes, walkers) are used by individuals with difficulty performing a task, whereas wheelchairs tend to be used by individuals who could not otherwise perform the task [6].

Wheelchairs, like ATDS in general, span the technology spectrum [12]. At the origin is the standard, sling upholstery, chrome-plated, steel folding X-frame design, standard, “depot” manual wheelchair. On the other end of the continuum are electric power wheelchairs with options for tilt and recline - allowing postural changes that reduce pressure and thus the risk for the formation of pressure ulcers [13, 14], seat elevation - which can provide assistance when transferring from the wheelchair to another surface and allow users to hold eye-level discussions with colleagues, and programmable electronic controls - that can be individualized for abnormal muscle tone,

tremor, and cognitive impairment [15]. Substantial improvements in wheeled mobility offer consumers more and better choices [16-20]. However, as the technology becomes more complex, so do the decisions as to who gets what wheelchair, with both cost and clinical expertise as factors. Clinicians making these decisions may not have training in wheeled mobility options and features, thus may have difficulty in comprehending the complexity of the technology and its application [21-25].

Studies of the use and benefits of AT typically include wheelchairs [5, 11, 26], but do not differentiate among types or quality of wheelchairs. Other studies have investigated the quality and durability of wheelchairs [27-32]. Only one other study, presently in press, was found that examined the relationship between demographic and clinical characteristics and types of wheelchairs. The purpose of this study was to characterize veterans (according to age, gender, race/ethnicity, diagnosis, number of comorbidities) who received wheeled mobility devices from the VHA, and to determine whether demographic characteristics vary significantly according to the type of wheeled mobility device (WMD) provided. We investigated how many veterans received initial issue, spare, and replacement wheelchairs from the VHA during each of the fiscal years (FY) 1999, 2000, and 2001, the demographic characteristics of the veterans receiving these wheelchairs, and their most frequent diagnoses. Our hypothesis was the type of wheelchair provided to veterans would differ significantly according to age, gender, and race/ethnicity for FY99, FY00, and FY01 combined. Analyses were performed for manual and power wheelchairs and scooters inclusive, and separate analyses were performed for manual and power wheelchairs.

2.3 METHODS

2.3.1 Design and Participants

Using a cross-sectional, retrospective study design, three years of data from two VHA databases, the NPPD and the National Patient Care Database (NPCD) were merged to create a dataset of demographic and clinical information on veterans who received wheeled mobility devices from the VHA during FY99, FY00, and FY01.

2.3.2 Databases

NPPD: The National Patient Prosthetics Database (NPPD), housed at the Veteran Administration Central Offices (VACO) [33, 34], contains detailed information on the procurement of prosthetic, orthotic, and sensory technology by tracking every device issued to veterans by the VHA. Seven of the 25 data fields included in the NPPD were used in this study: code and description of the device, type of service (initial issue, replacement, or spare), create date, delivery date, category of service, and priority group.

NPCD: The National Patient Care Database (NPCD) [35], housed at the Austin Automation Center (AAC), contains VHA outpatient and inpatient health care administrative datasets. The NPCD data fields used in this study included date of birth, sex, race, and primary and secondary International Classification of Disease - Revision 9 (ICD-9) codes [36]. Data from both the inpatient and outpatient databases was used to decrease the number of missing values. For example, if gender was missing in the inpatient dataset, it was retrieved from the outpatient dataset.

2.3.3 Operational Definitions of Variables

Dependent Variable

Type of Wheelchair: Wheelchairs sold in the U.S. must be approved as devices by the U.S. Food and Drug Administration (FDA) [37]. The FDA then forwards application information to the Center for Medicare and Medicaid Services (CMS). CMS [38] assigns the wheelchair a Health Care Common Procedure Coding System (HCPCS) code, developed for reimbursement purposes. Because of the large quantity of unique wheelchair-related HCPCS codes included in the NPPD (N=71), analysis of each wheelchair code was not feasible; therefore, for the purpose of this study, the HCPCS codes used in the NPPD to describe wheelchairs were assigned by the investigators to one of eight types based on function, weight, and adjustability. Adjustability (i.e. axle position, camber for manual wheelchairs and position of wheels, tilt, recline options, etc.) is essential to customizing a wheelchair to meet individual needs. See Table 3 for the assigned wheelchair types by K-code. See Appendix A for a full list of HCPCS codes used in the NPPD, including E-codes.

Table 3 Operational definitions of dependent variable: wheelchair type

Code	Type of Wheelchair	Description
K0001 = manual wc depot	M1	> 36 lbs, non-adjustable; "depot" wheelchair
K0002 = manual wc hemiplegia		> 36 lbs, non-adjustable, lower seat only; depot wheelchair
K0003 = manual wc lightweight		≤ 36 lbs, non-adjustable; lightweight, depot wheelchair
K0004 = manual wc lightweight	M2	<34 lbs., adjustable seat/back height, some adjustment in axle; high strength, lightweight; rehabilitation wheelchair
K0005 = manual wc ultralight	M3	< 30 lbs., adjustable seat/back height/axle/camber; ultralight wheelchair
K0006-7 = manual wc heavy duty	M4	Miscellaneous manual wheelchairs
K0009 = manual wc other		
K0010 = power wc	P1	non-adjustable, seat height only, standard weight non-programmable controls
K0011 = power wc	P2	Miscellaneous power wheelchairs
K0012 = power wc		
K0014 = power wc	P3	custom power wheelchairs, other motorized wheelchair base
E1230 = scooter	S1	scooter

Independent Variables

Age: Veteran age was calculated by subtracting the day on which the wheelchair order was entered into the system from the date of birth. VHA policy specifies the device must be entered within five days of prescription.

Race: Race (term used in the NPPD) was initially defined according to the six NPCD race categories: Hispanic Black, Hispanic White, American Indian, African American, Asian, and Caucasian. During the univariate chi-square analyses, it was determined Hispanic White, American Indian, and Asian had inadequate cell size for further analysis. Thus, Hispanic black and Hispanic white were combined and the remaining minority populations, American Indian and Asian, were combined.

Gender: Gender (sex was the term used in the NPPD) was specified as male or female.

2.3.4 Confounding Variables

Diagnosis: To determine the primary diagnosis, ICD-9 codes from the primary diagnoses variables for all FY99, FY00, and FY01 encounters for all participants were extracted from the inpatient and outpatient NPCD datasets. In order to characterize veterans by diagnosis, it was necessary for participants to have only one diagnosis, preferably the one most related to wheelchair-use. Thus, for the purpose of using SAS® to make this assignment, the 10 most frequent primary diagnoses were ranked (based on the authors' clinical experience) according to their likelihood of being the diagnosis most relevant to the wheelchair prescription. The most frequently occurring wheelchair-use related ICD-9 codes, in order of ranking were: amyotrophic lateral sclerosis (ALS), multiple sclerosis (MS), spinal cord injury-tetraplegia (SCIT), spinal cord injury-paraplegia (SCIP), stroke, traumatic brain injury (TBI), Parkinson's disease (PD), amputee, and chronic obstructive pulmonary disorder / chronic heart failure (COPD/CHF), and arthritis. An "other" category was established for primary diagnoses other than those listed.

A SAS® program was then written that used an array to rank the diagnoses. The rationale for the ranking was as follows: if a veteran had a diagnosis of SCI and arthritis, it was assumed that SCI played a more important role in wheelchair use than arthritis, thus SCI was considered the primary diagnosis and arthritis a comorbidity. ALS and MS were ordered in front of SCI because they are a primary condition and the spinal cord injury that occurs is secondary to the ALS and MS. For example, the SAS® program

would look for ALS ICD-9 code(s). If none were present, it would look for MS ICD-9 codes, and on down the rank. If the veteran did not have any of the listed diagnosis, the primary diagnosis was coded as “other”.

Comorbidities: To determine the number of comorbidities, ICD-9 codes representing secondary diagnoses were extracted from the FY99, FY00, and FY01 inpatient and outpatient NPCD datasets. The ICD-9 codes were sorted into 30 medical categories (anemia, chronic heart failure, diabetes, stroke, etc.) developed by Perlin and colleagues [39, 40] during the development of the Veteran Health Study (VHS). A continuous variable was created representing number of comorbidities. Since there were nine secondary diagnosis fields in the inpatient NPCD, and nine secondary diagnosis fields in the inpatient NPCD, there was a possibility for 18 comorbidities per veteran. If a veteran had a primary diagnosis that was also one of the 30 medical categories, the comorbidity count was adjusted, i.e. if the veteran’s primary diagnosis was stroke, the comorbidity count was reduced by one since stroke was also one of the 30 medical categories.

Fiscal Year: Fiscal year was specified either as FY99, FY00, or FY01.

2.3.5 Other Variables Included in Descriptive Analyses

Type of Service: Type of service designates whether the device issued was an initial issue, i.e. the first wheelchair the veteran had received, a spare, i.e. a back-up chair, or a replacement, i.e. for a wheelchair that was no longer operable or no longer met the veteran’s needs [41].

Priority Group: Congress requires the VA to manage the health care system using seven priority groups, which determine eligibility to receive health care benefits

each year. Priority Groups are defined as follows [7]: (1) veterans with service-connected disabilities rated $\geq 50\%$, (2) veterans with service-connected disabilities rated 30% or 40%, (3) veterans who are former Prisoners of War, have a service-connected disability rated 10% or 20%, discharged from active duty for a disability incurred or aggravated in the line of duty, received the Purple Heart, or were awarded special eligibility classification under 38 U.S.C., Section 1151, "benefits for individuals disabled by treatment or vocational rehabilitation", (4) veterans who are receiving aid and attendance or housebound benefits, or who have been determined by VA to be catastrophically disabled (i.e. SCI), (5) low income nonservice-connected veterans, (6) special category veterans (Agent Orange, radiation exposure) who are not required to make co-payments for their care, and (7) high income nonservice-connected and high income 0% service-connected veterans. While all enrolled veterans receive the same prosthetic benefits, regardless of priority level, knowing the priority groups of veterans who receive AT from the VHA contributes to an understanding of the relationship between level of disability, economic status, and AT use. In addition, veterans in priority groups 1 – 3 receive priority for scheduling of appointments that could affect prosthetic services. Should there be financial constraints, veterans classified in the higher priority groups (priority groups 1 - 5) would be granted priority consideration to receive health care benefits [42].

Category: There are four “categories” of service: service-related and inpatient (SC/IP), service-related and outpatient (SC/OP), non-service-related and inpatient service (NSC/IP), and non-service-related and outpatient (NSC/OP). Categories are assigned for each device provided, so for example, a veteran could have one wheelchair that is SC/OP and a scooter that is NSC/OP.

2.3.6 Procedures

Following approval by the VA Pittsburgh Healthcare System Institutional Review Board, the NPPD was provided by VACO and the demographic data from the NPCD were obtained from the AAC [33]. Unique scrambled patient identifiers from the NPPD were submitted to the AAC using a computer program written with SAS® [43] software. Within the AAC system, the scrambled patient identifiers were unscrambled long enough to secure the data for the specific veteran identifiers submitted. The patient identifiers were then re-scrambled and the NPCD data returned. Thus at no time did the investigators have access to unscrambled patient identifiers. SAS® [43] was used for all data retrieval and analyses.

Data Cleaning: Decision rules developed during a collaborative validity study of the NPPD [34] were applied. A comparison of the frequency counts of the records contained in the “NPPD_Line” and “HCPCSPSAS” fields determined the “NPPD_Line” field was the most reliable and valid method of selecting the wheelchair and scooter items. The “NPPD_Line” field is a VA code that specifies the type of device within 27 categories of devices. For example “100” represents wheelchairs, “100 A” represents power wheelchairs, and “100 C” represents wheelchair accessories” [35]. The “HCPCSPSAS” field is the Prosthetics and Sensory Aids Services (PSAS) code that corresponds to the CMS HCPCS code. The “HCPCSPSAS” and the CMS HCPCS codes are usually but not always the same. When inconsistencies between these fields were found, other fields including vendor, cost, and item description were considered, then the record recoded accordingly. For all three fiscal years (FY), only three wheeled mobility devices required recoding: a scooter and two manual wheelchairs.

2.4 ANALYSES

Descriptive methods (frequency, means, standard deviations, and medians for skewed data) were used to answer Research Question 1: the characterization of veterans according to number of wheelchairs and wheelchair components provided, type of service (initial issue, spare, replacement), gender, race/ethnicity, diagnosis, service category, priority group, age, and number of comorbidities. Because an extensive research study using NPPD data was not found and FY99 was the first year the NPPD was available to researchers, it seemed prudent to initially explore the data year by year rather than combining the three years of data. Thus, the demographic characterization was performed for each of the FYs, with the exception of priority group. Priority group data was not included in the NPPD until FY01. The data subset used to answer Research Question 1 included only wheelchairs and scooters; device components were excluded. Also only one record per veteran was included. For example, a veteran was only counted as male once, or as having a stroke as their primary diagnosis once.

ANOVA and chi-square univariate analyses and logistic regression were used to test Hypothesis 1: a determination of whether the characterization differed by wheelchair type. The three years of data were combined. In addition, since the focus of this analysis was on wheelchair types rather than the characteristics of veterans receiving wheelchairs, all wheelchair and scooter records per veteran were included (components were excluded). For example, a veteran may receive more than one wheelchair, or receive a wheelchair and a scooter, within a fiscal year, per VHA policy. This resulted however in some overlap in the data. For example, if a veteran received more than one wheelchair

per FY, their demographic data was counted more than once in the analysis of demographics – wheelchair relationship.

First, ANOVA and chi-square univariate analyses were performed between the independent variables (IV), potential confounding variables (CV), and the dependent variable (DV). The IVS were age, gender, and race/ethnicity. The CVS were diagnosis, number of comorbidities, and fiscal year. See Operational Definitions for details. The DV was type of wheelchair. Univariate analyses were tested at $\alpha = 0.10$. All IVS and CVS were significant thus all were entered into a logistic regression model. A separate logistic regression was run for each wheelchair type using four different data subsets: manual and power chairs and scooters, just manual chairs, just power chairs, and power chairs and scooters. The logistic regression model was tested at $\alpha = 0.5$. Odds ratios (OR), Wald confidence intervals (CI), and p-values were reported [43-46].

2.5 RESULTS

Table 4 displays the number of veterans who received wheelchairs, scooters, and wheelchair components from the VHA during FY99, FY00, and FY01. Approximately 70% of the wheeled-mobility related technology provided was either a wheelchair or scooter; the remaining 30% were wheelchair related components, i.e. cup holder, oxygen holder, gloves, seating system not associated with a wheelchair purchase. The number of veterans receiving wheelchairs, scooters, and/or related components was 77,249 in FY99, 80,753 in FY00, and 85156 in FY01; these numbers most accurately reflect wheelchair users. For example, a new seating system for a wheelchair provided prior to the study years would be considered a component. The 30% of veterans who received only components were likely wheelchair users whose chair did not need replacement during

the study years. In contrast, the number of veterans who received a wheelchair and/or scooter was 52,309 in FY99, 55,752 in FY00, and 59,877 in FY01.

Table 5 displays the number of wheeled mobility devices provided by the VHA. Approximately 80% of the wheelchairs provided in FY99 were manual, decreasing to 77% in FY01. The proportion of power wheelchairs increased from 8% in FY99 and FY00 to 14% in FY01, while the proportion of scooters provided decreased from 13% in FY99 and FY00 to 9% in FY01.

Table 4 Number and percentages of veterans receiving wheelchairs, scooters, and components during FY99, FY00, and FY01

Number of veterans who received:	FY99		FY00		FY01	
	#	%	#	%	#	%
Wheelchairs, scooters, and/or components	77249	100%	80753	100%	85156	100%
Wheelchairs & scooters	52309	68%	55752	69%	59877	70%

Table 5 Number and percentages of devices provided by the VHA during FY99, FY00, and FY01

Number of devices provided:	FY99		FY00		FY01	
	#	%	#	%	#	%
Wheelchairs - manual	48433	80%	49898	79%	52223	77%
Wheelchairs - power	4664	8%	5309	8%	9451	14%
Scooters	7015	13%	8144	13%	6187	9%

Table 6 displays the proportions of initial issue, replacement, and spare wheelchairs provided to veterans. More than 80% of the wheelchairs and scooters provided were the veteran’s first wheeled mobility device. Less than 1% were spares, and 17 - 18% were replacements. Tables 7 and 8, and Figure 7 display the demographic (age, gender, race, priority group) and clinical (diagnosis, number of comorbidities) characteristics. COPD/CHF was the most frequent primary diagnosis of veterans who received WMD followed by stroke.

Table 6 Number and percent of initial, spare, and replacement wheelchairs provided during FY99, FY00, and FY01

Type	FY99		FY00		FY01	
	#	%	#	%	#	%
Initial	48891	81%	52070	82%	5595	82%
Spare	396	1%	397	1%	347	1%
Replacement	10825	18%	10884	17%	11563	17%

Table 7 Gender, race/ethnicity, diagnosis, and priority group of veterans who received wheelchairs and scooters during FY99, FY00, and FY01

Variable	FY99		FY00		FY01	
	#	%	#	%	#	%
Gender Male	43783	96%	52305	96%	56503	96%
Female	1672	4%	1934	4%	2186	4%
Race Hispanic, Black	2180	5%	2961	5%	3157	5%
Hispanic, White	110	0%	187	0%	208	0%
American Indian	210	0%	233	0%	220	0%
Black	6749	15%	7724	14%	7905	13%
Asian	143	0%	164	0%	228	0%
White	30091	66%	34916	64%	36710	63%
Unknown	5971	13%	8054	15%	10261	17%
Diagnosis ALS	431	1%	545	1%	532	1%
MS	1661	4%	1862	3%	1957	3%
SCI-tetra	2015	4%	2111	4%	2166	3%
SCI-para	1677	4%	1670	3%	1766	3%
Stroke	7645	17%	8688	16%	8619	15%
TBI	56	0%	58	0%	48	0%
PD	1199	3%	1575	3%	1835	3%
Amputee	2106	5%	2323	4%	2176	4%
COPD/CHF	10245	23%	12191	23%	13035	22%
Arthritis	5059	11%	6180	11%	7033	12%
Other	13227	29%	16853	31%	19297	33%
Priority Group 1	Priority Group not included in NPPD until FY01				14988	26%
2					3190	6%
3					4703	8%
4					11919	21%
5					17511	31%
6					158	0%
7					2636	5%

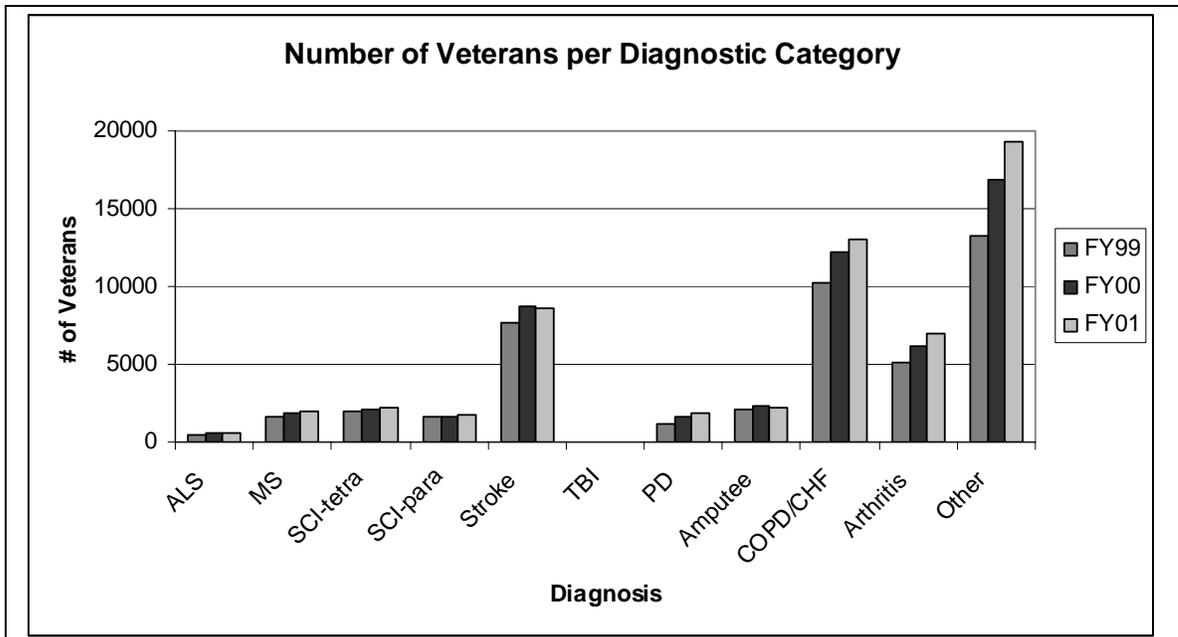


Figure 7 Number of veterans receiving wheelchairs and scooters per diagnostic group for FY99, FY00, and FY01

Table 8 Mean age and number of comorbidities of veterans who received wheelchairs and scooters during FY99, FY00, and FY01

Variable	FY99			FY00			FY01		
	<i>n</i>	mean	std dev	<i>n</i>	mean	std dev	<i>n</i>	mean	std dev
Age in Years	45455	66.6	13.1	54239	67.4	13.1	58689	67.8	13.0
# Comorbidities	43865	3.0	2.3	52606	3.0	2.2	57096	3.0	2.2

Figure 8 compares the priority groups of veterans who received WMD from the VHA during FY01, the general veteran population [7], and veterans who receive their healthcare from the VHA (as identified by the 1999 VHS) [40]. As expected, veterans with disabilities rated 50% or more and catastrophic (priority groups 1 and 4) were more than twice as likely to have received a wheelchair versus the general veteran population and veterans who receive their healthcare from the VHA. Veterans with disabilities rated 40% or less and low-income veterans (priority groups 2, 3 and 5), were only slightly less likely to have received a wheelchair versus the general veteran population. Relatively few

veterans who receive wheelchairs from the VHA are in the higher income/co-pay priority group 7.

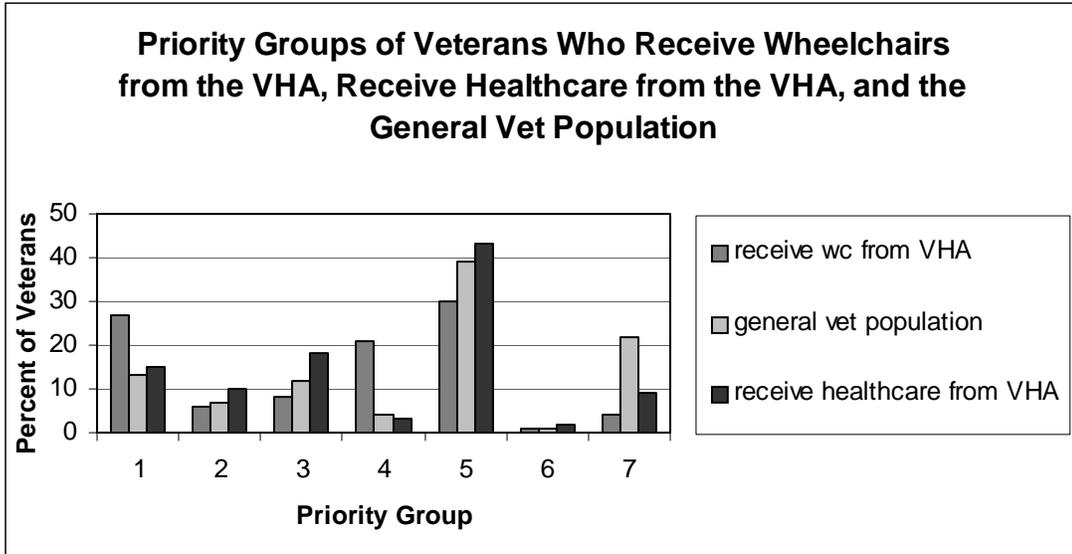


Figure 8 Priority groups of veterans who received wheelchairs from the VHA versus priority groups of entire veteran population for FY01

Univariate Analyses: According to the univariate analyses, in a distribution that was generally 98% male and 4% female, more male veterans (97%) received Type M1 (depot chairs) and fewer male veterans (95%) received Type P1 (standard power chairs). See Table 9 for the number and percent of wheelchairs and scooters provided to males versus females for all wheelchair types. Approximately 5 - 6% of the data had missing values for gender.

Table 9 Univariate analysis results: gender by wheelchair type and by manual/power wheelchairs and scooters for FY99-FY01 combined

		IV: Gender				
		freq male	% male	freq female	% female	p value
DV: Type of Wheelchair	M1	92261	97%	3275	3%	<.0001
	M2	28090	96%	1150	4%	
	M3	4498	96%	193	4%	
	M4	11672	96%	476	4%	
	P1	6118	95%	302	5%	
	P2	4884	96%	204	4%	
	P3	3673	96%	148	4%	
	S1	22477	96%	886	4%	
	manual	136521	96%	5094	4%	0.0004
	power	14675	96%	654	4%	<.0001
	scooter	22477	96%	886	4%	0.325

More variance in the type of wheelchair provided was noted between Hispanics and Caucasians than between African Americans and Caucasians (Table 10). When comparing all WMD (the first eight rows of Table 10), Hispanics received higher percentages of Types M1 and M3 (depot and ultralight wheelchairs) and lower percentages of Types P1 and S1 (standard power wheelchairs and scooters) than other race/ethnic categories. All three minority categories received a higher percentage Type M1 (depot chairs) than Caucasians. Caucasians received a higher proportion of scooters than minorities.

When comparing the proportion of manual and power wheelchairs and scooters per ethnic group (rows 9-11 of Table 10), 90% of the WMDS received by Hispanics were manual chairs, 5% were power chairs, and 5% were scooters. In contrast, 77% of the WMDS received by Caucasians were manual chairs, 9% were power chairs, and 14% were scooters. The percentages for African Americans were in between those for

Hispanics and Caucasians: 82% were manual chairs, 8% were power chairs, and 10% were scooters. With the exception of Types M1 and S1 (depot chairs and scooters), there was relatively little variance in types of wheelchairs received by African Americans compared to types of wheelchairs received by Caucasians. Approximately 5 to 6% of the race/ethnicity data had missing values.

Table 10 Univariate analysis results: race/ethnicity by wheelchair type and by manual/power wheelchairs and scooters for FY99-FY01 combined

		IV: Race/Ethnicity											
		Hispanic		Am Indian Asian		African Am		Caucasian		p value	Total Devices		
		#	%	#	%	#	%	#	%		#	%	
DV: Type of Wheelchair	M1	6677	68%	861	63%	14599	57%	60216	52%	<.0001	82353	53%	
	M2	1461	15%	192	14%	3779	15%	18590	16%		24022	16%	
	M3	435	4%	39	3%	734	3%	2758	3%		3966	3%	
	M4	237	2%	58	4%	1903	7%	8083	7%		10281	7%	
	P1	199	2%	47	3%	882	3%	4262	4%		5390	4%	
	P2	141	1%	39	3%	704	3%	3354	3%		4238	3%	
	P3	171	2%	23	2%	587	2%	2561	2%		3342	2%	
	S1	522	5%	104	8%	2454	10%	16248	14%		19328	13%	
	manual	8810	90%	1150	84%	21015	82%	89647	77%		<.0001	120622	79%
	power	511	5%	109	8%	2173	8%	10177	9%		<.0001	12970	8%
scooter	522	5%	104	8%	2454	10%	16248	14%	<.0001	19328	13%		
devices per race/ethnic category		9843	5%	1363	<1%	25642	14%	116072	64%				

The average age of veterans receiving Types M3 and P3 (ultralight and custom power wheelchairs) was 55 (16) and 60 (14) respectively, compared to the average age of veterans receiving Types M1, M2, and S1 (depot, lightweight rehabilitation wheelchairs and scooters): 67 (13), 66 (14), and 66 (12) respectively. See Table 11 for age means and standard deviations. Age was normally distributed for all wheelchairs types. The percentage of missing values for age of veterans ranged from 56% to 69% across

wheelchair types. Age was calculated from the date the wheelchair was ordered and the veteran's date of birth, so either of these fields could have contributed a missing value.

Table 11 Univariate analysis results: mean and standard deviation of age by wheelchair type and manual/power wheelchairs and scooters for FY99-01 combined

		IV: Age			
		<i>n</i>	mean	std dev	p value
DV: Type of Wheelchair	M1	33053	67.0	13.1	<.0001
	M2	9749	65.5	13.9	
	M3	1835	55.2	15.8	
	M4	4732	62.5	13.9	
	manual	49369	65.8	13.7	
	P1	3025	62.0	13.6	
	P2	1838	62.7	13.5	
	P3	1670	59.9	13.9	
	power	6533	61.7	13.7	
	S1 -scooter	8787	65.5	11.6	

The most frequently prescribed type of wheelchair for all diagnoses was the M1 (depot chair). See Table 12. The second most frequently prescribed wheelchair type varied by diagnosis: type M2 (lightweight rehabilitation wheelchairs) for veterans with MS, SCI, stroke, TBI, PD and amputee, type S1 (scooters) for veterans with ALS, COPD/CHF, and arthritis. Power devices, Types P1-P3 and S1 (power wheelchairs and scooters) were prescribed more often for veterans with ALS, MS, and SCI-tetraplegia (~40%) than for veterans with SCI-paraplegia, stroke, TBI, PD, amputee, COPD/CHF, and arthritis (<30%). Approximately 5% of the diagnosis data had missing values.

Table 13 provides similar data as Table 12, the difference being that manual wheelchairs were analyzed separately from power wheelchairs, and scooters were excluded since there was only one type, thus no comparison. Whereas Table 12 displays

the most frequently prescribed wheelchairs across diagnoses, Table 13 displays the type of chair most frequently prescribed within a diagnosis.

Table 12 Univariate analysis results: frequency of wheelchairs by type and manual/power wheelchairs and scooters across diagnoses for FY99-01 combined

		DV: Wheelchair Type										P value
		M1	M2	M3	M4	Manual	P1	P2	P3	Power	S1	
Confounding Variable: Dx	ALS	37%**	13%	2%	8%	60%	8%	9%	6%	40%	16%*	<.0001
	MS	27%**	16%*	7%	8%	58%	12%	8%	9%	43%	13%	
	SCIT	23%**	15%*	13%	11%	62%	13%	7%	12%	38%	6%	
	SCIP	28%**	20%*	13%	11%	73%	7%	5%	5%	27%	10%	
	Stoke	55%**	19%*	2%	6%	83%	3%	3%	1%	17%	10%	
	TBI	58%**	14%*	1%	10%	83%	1%	1%	1%	17%	14%*	
	PD	59%**	20%*	2%	5%	86%	2%	2%	1%	14%	9%	
	Amputee	48%**	19%*	3%	7%	78%	4%	3%	2%	22%	13%	
	COPD/CHF	52%**	14%	1%	6%	73%	3%	2%	1%	27%	21%*	
	Arthritis	54%**	15%	1%	7%	78%	3%	2%	1%	22%	16%*	

**most frequently provided wheelchair type per diagnostic group

*2nd frequently provided wheelchair type per diagnostic group

Table 13 Univariate analysis results: frequency of type of manual and power wheelchairs diagnoses for FY99-01 combined

DV: Wheelchair Type											
	ALS	MS	SCIT	SCIP	Stoke	TBI	PD	Amputee	COPD/CHF	Arthritis	
DV: Wheelchair Type	Manual Wheelchairs										
	M1	62%	48%	38%	39%	67%	70%	69%	63%	72%	70%
	M2	22%	27%	24%	27%	23%	16%	23%	24%	19%	19%
	M3	4%	12%	21%	18%	2%	1%	2%	4%	1%	2%
	M4	13%	14%	17%	15%	8%	12%	6%	8%	9%	9%
	Power Wheelchairs										
	P1	36%	42%	40%	41%	43%	40%	43%	43%	40%	46%
	P2	39%	27%	23%	31%	38%	40%	34%	34%	39%	36%
	P3	25%	32%	37%	28%	19%	20%	22%	22%	22%	18%

The mean number of comorbidities (Table 14) appears to be lower for Type M3 (ultralight) and Types P1 and P3 (standard and custom power wheelchairs); however, relatively large standard deviations preclude making this assumption. The percent of missing values for the number of comorbidities data ranged from 6% to 12% across wheelchair types.

Table 14 Univariate analysis results: mean and standard deviation of # of comorbidities by wheelchair type and manual/power wheelchairs and scooters for FY99-01 combined

Confounding Variable: # of Comorbidities					
		<i>n</i>	mean	std dev	p value
DV: Type of Wheelchair	M1	92870	3.0	2.2	<.0001
	M2	28218	2.9	2.2	
	M3	4535	2.3	2.1	
	M4	11803	3.0	2.2	
	manual	137426	30.0	2.2	
	P1	6624	2.9	2.4	
	P2	4906	3.0	2.4	
	P3	3719	2.8	2.4	
	power	14849	2.9	2.4	
	S1 -scooter	22773	3.2	2.3	

Logistic Regression Results: Tables 15-18 display the likelihood of veterans to receive a certain type of wheelchair if they are older versus younger, male versus female, and Hispanic versus Caucasian, American Indian/Asian versus Caucasian, or African American versus Caucasian. The results displayed in Table 15 were derived from a data subset that included all WMD (manual and power wheelchairs and scooters). The results displayed in Table 16 were derived from a data subset that included only manual wheelchairs, Table 17 power wheelchairs and scooters, and Table 18 only power wheelchairs.

Age: When comparing all WMD, younger veterans were more likely to receive Types P3 (custom power wheelchairs) ($p=.027$) and S1 (scooters) ($p<.0001$) whereas older veterans were more likely to receive Types M1-M4 (manual wheelchairs) ($p<.0001$). Within manual wheelchairs, older veterans were more likely to receive Type M1 (depot chairs) ($p<.0001$) while younger veterans were more likely to receive Type M3 (ultralight wheelchairs) ($p<.0001$).

According to adjusted OR (when comparing all WMD), as an example, a veteran age 70 was 1.04 times more likely to receive a manual wheelchair (Types M1-M4) than a veteran age 60. Similarly, a veteran age 60 was 1.04 times more likely to receive a power wheelchair or scooter (Types P1-P4 and S1) than a veteran age 70. When comparing the adjusted OR for Types M1-M4 (manual wheelchairs), for every 10-year gain in age, a veteran was 1.08 times more likely to receive a Type M1 (depot chair) and 1.04 times more likely to receive a Type M2 (lightweight wheelchair). For every 10-year decrease in age, a veteran was 1.25 times more likely to receive a Type M3 (ultralight wheelchair).

Race: When comparing all wheeled mobility devices (Table 15), Hispanics (OR=1.9), American Indians & Asians (OR=1.6), and African Americans (OR=1.4) were more likely than Caucasians to receive Types M1-M4 (manual wheelchairs), Hispanics (OR=0.8) and African Americans (OR=0.9) were less likely than Caucasians to receive Types P1-P3 (power wheelchairs), and Hispanics (OR=0.4), American Indians & Asians (OR=0.4), and African Americans (OR=0.7) were less likely than Caucasians to receive scooters. This was not the effect however, when manual wheelchairs and power wheelchairs were compared separately.

When including only manual wheelchairs in the analysis (Table 16), Hispanics were more likely than Caucasians to receive Type M1 (depot) (OR=1.7) and Type M3 (ultralight) (OR=1.8) wheelchairs. Hispanics (OR=0.7) and African Americans (OR=0.9) were less likely than Caucasians to receive Type M2 (lightweight) wheelchairs.

When power wheelchairs and scooters were included in the analysis (manual wheelchair excluded) (Table 17), minorities were more likely than Caucasians to receive power chairs, Hispanics (OR=1.9), American Indian/Asians (OR=1.9), African American (OR=1.3), and less likely to receive Type S1 (scooters) Hispanics (OR=0.5), American Indian/Asians (OR=0.5), African American (OR=0.8).

When only power wheelchairs were included in the analysis (scooters and manual wheelchairs excluded) (Table 18), Hispanics were more likely than Caucasians to receive Type P3 (custom power) wheelchairs (OR=1.6).

Table 15 Regression results for manual vs power wheelchairs vs. scooters for FY99-01 combined

n=62377		Independent Variables															
		Age			Sex			Race/ethnicity									
					male			Hispanic vs Caucasian			American Indian/Asian vs Caucasian			African American vs Caucasian			
		%	OR	95% CI	p	OR	95% CI	p	OR	95% CI	p	OR	95% CI	p	OR	95% CI	p
DV Wheelchair Type	manual	76%	1.003	1.002-1.005	<.0001	1.061	0.961-1.171	0.242	1.864	1.682-2.067	<.0001	1.585	1.247-2.015	0.0002	1.360	1.285-1.440	<.0001
	power	10%	1.000	0.998-1.002	1.000	0.889	0.776-1.018	0.089	0.804	0.703-0.918	0.001	1.036	0.772-1.391	0.813	0.881	0.815-0.953	0.002
	scooter	14%	0.995	0.993-0.997	<.0001	1.006	0.891-1.135	0.929	0.422	0.364-0.488	<.0001	0.413	0.286-0.597	<.0001	0.682	0.634-0.734	<.0001
significant at 0.05 & CI does not include 1																	
% = percent of wheelchairs in sample that were of type of wheelchair being analyzed																	

Table 16 Regression results for manual wheelchairs for FY99-01 combined

n=47436		Independent Variables															
		Age			Sex			Race/ethnicity									
					male			Hispanic vs vs Caucasian			American Indian/Asian vs Caucasian			African American vs Caucasian			
		%	OR	95% CI	p	OR	95% CI	p	OR	95% CI	p	OR	95% CI	p	OR	95% CI	p
DV Wheelchair Type	M1	66%	1.008	1.006-1.010	<.0001	1.064	0.957-1.182	0.250	1.709	1.554-1.878	<.0001	1.553	1.232-1.958	0.0002	1.087	1.029-1.149	0.003
	M2	20%	1.003	1.002-1.005	0.0004	0.907	0.804-1.023	0.113	0.665	0.595-0.744	<.0001	0.775	0.594-1.011	0.060	0.870	0.815-0.928	<.0001
	M3	4%	0.978	0.974-0.982	<.0001	1.006	0.780-1.298	0.962	1.766	1.475-2.114	<.0001	0.733	0.394-1.363	0.326	0.951	0.829-1.091	0.471
	M4	10%	0.984	0.982-0.987	<.0001	1.037	0.882-1.220	0.661	0.278	0.222-0.348	<.0001	0.591	0.393-0.889	0.012	1.062	0.978-1.154	0.151
significant at 0.05 & CI does not include 1																	
% = percent of wheelchairs in sample that were of type of wheelchair being analyzed																	

Table 17 Regression results for power wheelchairs and scooters for FY99-01 combined

n=14816		Independent Variables															
		Age			Sex			Race/ethnicity									
					male			Hispanic vs Caucasian			American Indian/Asian vs Caucasian			African American vs Caucasian			
%		OR	95% CI	p	OR	95% CI	p	OR	95% CI	p	OR	95% CI	p	OR	95% CI	p	
DV:WC Type	Power	19%	1.000	0.997-1.003	0.887	0.936	0.784-1.118	0.468	1.850	1.518-2.254	<.0001	1.928	1.190-3.124	0.008	1.256	1.129-1.397	<.0001
	Scoot	58%	1.000	0.997-1.003	0.887	1.068	0.894-1.275	0.468	0.541	0.444-0.659	<.0001	0.519	0.320-0.840	0.008	0.796	0.716-0.886	<.0001
significant at 0.05 & CI does not include 1																	

%=percent of wheelchairs in sample that were of type of wheelchair being analyzed

Table 18 Regression results for power wheelchairs for FY99-01

n=6278		Independent Variables															
		Age			Sex			Race/ethnicity									
					male			Hispanic vs Caucasian			American Indian/Asian vs Caucasian			African American vs Caucasian			
%		OR	95% CI	p	OR	95% CI	p	OR	95% CI	p	OR	95% CI	p	OR	95% CI	p	
DV Wheelchair Type	P1	46%	1.001	0.996-1.005	0.799	0.879	0.688-1.123	0.302	0.901	0.702-1.157	0.413	0.925	0.538-1.591	0.778	1.018	0.882-1.175	0.809
	P2	28%	1.004	1.000-1.009	0.067	1.128	0.853-1.491	0.397	0.706	0.523-0.953	0.023	1.658	0.944-2.911	0.078	0.997	0.851-1.169	0.974
	P3	26%	0.994	0.990-0.999	0.027	1.048	0.788-1.394	0.748	1.564	1.198-2.041	0.001	0.615	0.314-1.204	0.156	0.978	0.830-1.152	0.792
significant at 0.05 & CI does not include 1																	

%=percent of wheelchairs in sample that were of type of wheelchair being analyzed

2.6 DISCUSSION

Demographic and clinical outcomes of the provision of wheelchairs and scooters by the VHA were examined. The purpose was twofold: to characterize veterans who received wheeled mobility devices (by age, gender, race/ethnicity, diagnosis, number of comorbidities, priority group) and to determine whether a significant relationship exists between type of wheelchair and age, gender, or race/ethnicity (controlling for diagnosis and number of comorbidities). Studies investigating demographic differences of individual who receive and/or use AT have included wheelchairs [5, 11, 26]. These studies have assumed all wheelchairs are created equal, i.e. included wheelchairs as one category of AT. Most studies that have compared types of wheelchairs have focused on the durability of the device [27-30]. There is one known study, in press, [47] that examined the association between wheelchairs categorized according to their customizability and demographic and socioeconomic factors. Manual wheelchairs were categorized into two types: adjustable and non-adjustable. Power wheelchairs were categorized into three types: standard without programmable controls, standard with programmable controls, and custom with programmable controls. Participants included 412 fulltime wheelchair users with SCI. In comparison, the study described herein categorized wheelchairs and scooters into eight types: four types of manual wheelchairs and three types of power wheelchairs and scooters (based on function, adjustability and customizability). Participants were veterans representing a range of diagnoses who received WMDS from the VHA. The average veteran participant was a white, 69 year old male, with COPD/CHF and three comorbidities, who was receiving his wheeled mobility device for a condition that was not incurred during military service.

Although the veteran population is decreasing (~ 3% from FY99 to FY01), the percent of veterans receiving services from the VHA is increasing (~ 3% from FY99 to FY01) [7]. During this same 3-year period, this study found number of veterans receiving wheelchairs and scooters has increased by 13%. Approximately 2% of veterans who receive their healthcare from the VHA received wheelchair related AT from the VHA.

Approximately 0.5% of the general veteran population received wheeled-related technology from the VHA, a figure similar to the 0.6% of the U.S. general population reporting themselves as wheelchair users [2].

In FY99, 60,116 wheelchairs and scooters were provided by the VHA to 52,309 veterans. If a one to one correspondence between wheeled mobility devices and individuals receiving the devices is assumed, there were 7,803 more wheelchairs and scooters provided than there were veterans to receive them. This suggests some veterans received more than one wheelchair during a FY, in accordance with VHA Handbook that states veterans “who require the constant and continued use of a wheelchair are to be furnished a second manual wheelchair . . . when absence of a manual wheelchair during repair periods would create a severe hardship” [41]. Further, the handbook states “spare motorized wheelchairs may be furnished when an unusual circumstance occurs” and the “issuance of a manually propelled wheelchair should be considered for all outpatients who have been furnished a motorized wheelchair” [41]. In fact ~ 1% of the wheelchairs provided were coded as spares, which would account for as many as 6000 of the 7,803 wheelchairs and scooters.

Upon examination of the data (a comparison of cost and code variables), a second factor emerged as an explanation of the difference between number of devices provided

and number of veterans receiving them. Wheelchair components were inconsistently coded as wheelchairs, perhaps in an effort to associate the component with the wheelchair it accompanies. Coding components as the actual device may have inflated the actual wheelchair count. Scooters tend not to have accessories or components, so the scooter count was less likely to be impacted. The numbers for FY00 were 63,551 devices provided to 55,752 veterans (a difference of 7,799 devices) and in FY01, 67,861 devices were provided to 59,877 veterans (a difference of 7,984).

A third factor is coding error. Consistency in coding (the second factor) among facilities must be implemented however, before the degree of coding error can be determined.

An interesting finding was that in FY00 scooters made up 13% of the WMDS provided to veterans, and power wheelchairs 9% of WMDS provided. In FY01 these percentages shifted to 8% scooters, and 14% power wheelchairs. This change is attributed to advances in power wheelchair technology, i.e. availability of front-wheel, mid-wheel and rear-wheel drive allowing for indoor and outdoor use.

Race: Most research investigating the relationship between race/ethnicity and the use of AT [5, 11] has compared African Americans and Caucasians. This study found more variance between Hispanics and Caucasians than between Caucasians and African Americans.

According to FY01 NPPD data and FY01 VA statistics for the general veteran population [7], 63% of veterans receiving wheeled mobility devices from the VHA were Caucasian, 13% were African American, and 5% Hispanic. During the same FY, 85% the general veteran population was Caucasian [7], 9% African American, and 4.5% Hispanic.

Thus the Caucasian and African American veterans receiving wheelchairs from the VHA were disproportionate to the general veteran population.

Race/ethnicity statistics for veterans receiving their healthcare from the VHA was only found in the 1999 VHS report [40]. When comparing VHS results with FY99 NPPD data, 66% of veterans receiving wheeled mobility devices from the VHA were Caucasian, 15% were African American, and 5% Hispanic. During the same FY, 73% of veterans receiving their healthcare from the VHA were Caucasian, 15% were African American, and 6% Hispanic. In this comparison, only Caucasians are disproportionate. The following discussion will reveal that Caucasians share equal risk for injury in combat. Both of the previously comparisons reveal that a fewer proportion of Caucasians however receive their healthcare or wheeled mobility devices from the VHA.

Presently, a trend of increasing minorities in the VA general population exists [7]. For example, between FY00 and FY01 the percentage of African Americans increased by 1.4% while the percentage of Caucasians decreased by 0.8% [7]. There has been an increase in the proportion of Hispanics receiving wheeled mobility devices (0.5% over FY99-FY01) and a decrease in the proportion of Caucasians (2.5% FY99 to FY01) and African Americans (nearly 1.5% FY99 to FY01) receiving wheeled mobility devices. Not only are a higher proportion of Hispanics are receiving their wheelchairs from the VHA, they tend to receive the more adjustable ultralight manual and custom power wheelchairs.

Publications can be found both in supporting [48-50] and denying [51-54] that since the Vietnam War, the percent of minority soldiers who have been wounded or died in action has been disproportionate. Few African Americans and Hispanics were assigned to front-line combat units during World War II [52]. It was during the Korean War that

the military became racially integrated; parity with the population percent was approached during the Vietnam War [52]. During the Vietnam War, 10.6% of the troops and 12-12.5% of the casualties and deaths were African American veterans, while 12-13.5% of the U.S. population was African American [49, 52, 55]. During Vietnam, Hispanics were classified by the Department of Defense (DoD) as “whites”. The DoD database was sampled by Hispanic surnames yielding the estimate that 5-6% of the troops serving in Vietnam were Hispanic, when Hispanics made up 4.5% of the U.S. population [49]. Estimates of Hispanic deaths in Vietnam range from 0.6% [52] to 5.2% [55] to 5.5% [56]. Since Vietnam, African American soldiers have opted for technical and communications positions that do not involve direct combat, i.e. positions that provide marketable skills upon discharge [48, 49, 52]. In the 1991 Gulf War, 17% of the fatalities were African Americans and 4.1% Hispanic [52] when the U.S. population was 18% African American and 4% Hispanic [7]. In the Iraq war, the front line combat force is mostly Caucasian [50] , though unfortunately, the non-combat, support troops in Iraq have been unexpectedly subject to battle [52].

In summary, the increased likelihood of Hispanics to receive ultralight and custom wheelchairs does not appear to bear a relationship to representation in front-line combat. In addition, more than 50% of the ultralight and custom wheelchairs were prescribed for non-service connected injuries. Subsequent analyses performed by this research team controlling for VISN, service category, and priority group yield a slight increase in the likelihood of Hispanics to receive ultralight and power wheelchairs. Future studies could repeat this analysis controlling for facility rather than the VISN to determine more specifically whether location is a factor. For example, a SCI specialty

center in an area with a high Hispanic population may prescribe more ultralight and custom wheelchairs, which may not be reflected when the analysis is performed by VISN.

Evidence that Caucasians were more likely to receive scooters than minority groups was found in both comparisons that included scooters in the data subsets: all wheeled mobility devices and power wheelchairs and scooters. This finding may reflect the aging status of the World War II veterans who now require WMDS for nonservice-connected conditions such as COPD and arthritis. It was established in a previous paragraph that there were very few minority veterans in World War II, therefore, it is not surprising that the older veterans receiving scooters are predominantly Caucasian.

The study described herein and a study by Hunt et. al [47] found minorities were more likely than Caucasians to receive standard manual wheelchairs when only manual wheelchairs are considered. These two studies classified manual chairs differently. Hunt et. al [47] considered the lightweight rehabilitation wheelchair as a standard wheelchair whereas the study described herein created a third category for the lightweight chair. Thus when comparing the fully customizable ultralight manual wheelchair with the lightweight rehabilitation wheelchair, the study described herein found Hispanics were more likely to receive the customizable ultralight chair whereas Caucasians were more likely to receive the light weight rehabilitation wheelchair, an unexpected finding that deserves further investigation.

The study described herein and the study by Hunt et. al [47] used a similar categorization of power wheelchairs: a standard power chair without programmable controls, a standard power chair with programmable controls, and a customizable

wheelchair. In the Hunt et. al [47] study, none of the participants received a standard wheelchair without programmable controls. Minorities were more likely to receive standard wheelchairs with programmable controls, and Caucasians customizable wheelchairs. It should be noted Hunt et. al's [47] study only included individuals with SCI recruited from the National Spinal Cord Injury Model Systems database, funded by the Department of Education. In the study described herein, the standard wheelchair without programmable controls was the most frequently prescribed power wheelchair for individuals with tetraplegia and paraplegia due to SCI. It was beyond the scope of the study described herein to compare type of wheelchair by diagnosis and race/ethnicity because of the increasing complexity and quantity of the data. Rather, because diagnosis was a significant determinant of type of wheelchair prescribed, it was used as a control variable. A proposal has been submitted to study the provision and utilization of ATDS within diagnosis (stroke).

Diagnosis: Type M1 (depot) wheelchairs were provided more than 50% of the time for veterans with stroke, TBI, PD, COPD/CHF, and arthritis. Conditions such as stroke and TBI may require only temporary use of a wheelchair. For example, in a study of use or nonuse of the wheelchair following a stroke, Garber and colleagues [57] found 31% of participants stopped using their wheelchair, all of which were manual wheelchairs, typically because of improved physical function or use of alternative mobility devices such as walkers or canes. Veterans with COPD/CHF and arthritis may be household ambulators, but require a wheelchair for longer distances. Type M1 (depot) chairs may be considered a more cost effective solution to part time wheelchair use. Depot wheelchairs do however require more exertion and energy to propel [19, 58],

which needs to be considered when prescribing a wheelchair for veterans with deconditioning disorders.

Veterans with SCI and some veterans with MS are more likely to rely on their wheelchairs for mobility. Veterans with SCI and MS received Type M1 (depot) chairs less than 30% of the time. In contrast, Hunt et. al [47], in their study of full-time wheelchair users with SCI who received their wheelchairs from SCI centers of excellence, found 97% of manual wheelchair users had customizable chairs (equivalent to the ultralight wheelchair). The remaining 3% used manual wheelchairs that were not ultralights. Because of differences in gathering and coding the information and reporting the data, only approximate comparisons can be made between the findings of the Hunt et. al study and the study described herein. However, a secondary univariate analysis found 38% of veterans with SCI received standard, depot manual wheelchairs from the VHA, and 20% received customizable, ultralight wheelchairs. Caution is advised when interpreting these comparisons as some of the depot chairs provided may have been spares. It was beyond the scope of this study to conduct an in depth analysis of initial, spare, and replacement chairs by wheelchair type at the patient level.

None of the power wheelchair users in the Hunt et. al [47] study received a standard power chair without programmable controls, 46% received standard power chairs with programmable controls, and 54% received customizable chairs. In comparison, approximately 40% of veterans with SCI received standard power chairs without programmable controls from the VHA, 26% received standard power chairs with programmable controls, and 33% received customizable chairs.

The results of these two studies lead one to wonder if veterans with SCI are more likely to go to an SCI specialty-seating clinic for their wheelchairs. Hunt et. al [47] found participants with customizable wheelchairs were more likely to have private health insurance ($p = 0.018$). While specialty-seating clinics exist within the VHA, there is no way to differentiate which wheelchairs were prescribed by clinicians in these clinics. This is fact is one of the limitations of the NPPD and this study.

Service Category: Nearly 80% of the wheelchairs were prescribed for non-service related conditions. It should be noted that within the NPPD, one veteran can receive a wheeled mobility device for a service-connected and a nonservice-connected condition. For example, a veteran may receive an ultralight wheelchair for a service-connected injury (perhaps a SCI incurred while serving in Vietnam), and a scooter for a nonservice-connected condition (i.e. COPD as the veteran ages, and perhaps with a lifestyle that includes smoking and little exercise).

Secondary analyses revealed a higher proportion of depot (37% versus 26%) and lightweight (24% versus 19%) wheelchairs are provided for nonservice-connected conditions than service-connected conditions ($p < .0001$). A higher proportion of standard power (7% versus 4%), custom power (5% versus 3%), and scooters (22% versus 17%) wheelchairs are provided for service-connected conditions than nonservice-connected conditions ($p < .0001$). A limitation of this analysis is that it did not control for diagnosis. Diagnoses resulting from a service connected condition are likely to differ from those resulting from a nonservice-connected i.e. a veteran is less likely to receive a wheelchair for a diagnosis of COPD or arthritis while on active duty.

Age: Younger veterans were more likely to receive ultralight wheelchairs. These veterans, mean age = 55, who may be more active, more likely to compete in sports, and associate with peers who use sportier wheelchairs, are likely Vietnam veterans. Older veterans, mean age = 67, likely World War II veterans, were more likely to receive depot chairs. If older veterans are perceived as less active, they may also be perceived as having less need for sportier chairs. The problem with this logic is depot wheelchairs are heavier and non-adjustable therefore increase the demands upon already arthritic joints for propulsion. The lighter the chair, the easier it is to push. Wheelchair propulsion requires the upper extremities to produce repeated, forceful movements, which can result in carpal tunnel syndrome and injury to the shoulder [59-64]. Lighter chairs reduce the propulsion workload, thus lower the risk of secondary injuries to the user's arms and shoulders [58, 65-67]. In addition, the heavier depot chairs are difficult to load into the car by aging caregivers. When World War II veterans were injured, depot chairs (patented in 1937) were the only available wheelchair design. If a veteran is a depot chair user, their replacement wheelchair is also likely to be a depot wheelchair. An analogy would be Iraq veterans who have recent blast injuries are receiving state of the art "C-leg" prosthetics, whereas veterans from previous wars are more likely to continue to use more traditional prosthetic extremities. It should be noted that while depot wheelchairs were the most frequently prescribed wheelchair, the lighter weight rehabilitation chairs are also being provided to older veterans, mean age = 65.5 years old. While rehabilitation wheelchairs are lighter weight, they do not provide the axle position adjustability that reduces the repetitive stress generated during propulsion [16].

Both the study described herein ($p = 0.27$) and the study by Hunt et. al [47] ($p = 0.28$) found younger individuals were more likely to receive customizable power wheelchairs ($p = 0.28$). Hunt et. al did not find significant age differences for manual wheelchairs, perhaps because the mean age of participants was 42 (14) and 97% of participants who used manual wheelchairs used an ultralight. In comparison, in the study described herein, the finding that veterans who received an ultralight manual wheelchair from the VHA (when all manual wheelchairs were compared) had a mean age of 55 (16) was significant ($p < .0001$).

The mean age of veterans receiving wheeled mobility devices from the VHA during FY99-01 was 67 (13), 9 years older than the general veteran population (mean age = 58) [7]. Similarly, the mean age of veteran wheelchair users and wheelchair users in the U.S. population [2, 10] was similar, 67 and over 65 years respectively.

Limitations: A limitation of health disparity research is that it tends to compare groups, most frequently racial/ethnic groups, without taking into consideration interrelated factors such as culture, environment, health behaviors and beliefs, literacy, SES, and power differentials [68]. Thus, caution must be taken when interpreting differences between groups.

A second limitation of this study is that it describes what was provided, but does not describe how it was prescribed. For example, the databases WMDS and scooters, i.e. where and by whom. We do not know which if any devices were prescribed by a specialty clinic, such as an SCI clinic, or a clinic staffed by clinicians trained and certified in seating and mobility technology.

A third limitation of this study is administrative databases, which “are the by-product of running a healthcare system” [69], do not provide information unique to each veteran, for example, a description of their mobility, activity, and participation needs and functional levels. Because functional level data was not available, the distinction between type of wheelchair per functional level could not be made. For example, veteran with a mild stroke will have different mobility needs than a veteran with a more massive brain stem stroke.

Policy Implications: In spite of its limitations, this study provides important policy implications. First, the VHA provides wheelchairs to veterans no matter what there priority group, though for some there may be a co-pay. Second the VHA provides not only an initial wheelchair, but will provide a spare wheelchair and a sports wheelchair (encouraging veterans to remain physically and socially active). Third, a profile of types of wheeled mobility devices provided by VHA facilities across the U.S. was provided and compared to a profile of devices provided by seating and 13 mobility specialty centers across the U.S. These are the first two studies known that have provided such information that can be used as a baseline from which to establish wheelchair prescription practice guidelines. What is missing from both these studies are the functional outcomes of the individuals who received the devices which ultimately are needed to determine if the prescription decision was in the best interest of the user. Alternatively, training in rapidly advancing seating and mobility technology training for clinicians may be indicated.

While the NPPD did provide a HCPCS code, there was no information on the make or model of the wheelchair, which could assist in policy decisions such as

competitive bidding, or in the validation some of the other NPPD fields, i.e. having a brand name, model number, and HCPCS code could differentiate inconsistencies in coding procedures across facilities and data entry persons within facilities, and identify coding error. It would also have been helpful to have been able to differentiate whether a chair was purchased from a vendor or from a manufacturer. The vendor field did not make this distinction clear.

While making inquiries about the data entry process at the facility level, it was found there might be discrepancies at times between prescription and provision at at least one facility. The clinician prescribes a wheelchair. The prescription is then given to a vendor. The vendor purchase order is entered into the VA system, and the device is delivered to the veteran's home (if outpatient). There appears to be no check built in to the system to insure that the vendor has ordered what the clinician prescribed, thus prescription should not be used interchangeably with provision.

While making inquiries among wheelchair vendors with Assistive Technology Specialist (ATS) certified by the Rehabilitation Engineering and Assistive Technology Society of North America (RESNA), it was found that the NPPD includes outdated HCPCS codes from the 1970s. It is possible that using outdated codes could contribute to confusion between vendors and the VHA. It was unclear where these outdated "E" codes where originating: from the vendor or the VHA, but ATS vendors interviewed by the investigators were unfamiliar with most of the "E" codes. Knowing what happens to the wheelchair after it is delivered should be included in the continuum of care of the veteran. Tracking what happens to the chair is also important. Wheelchairs, especially power wheelchairs, are expensive, and frequently take many months before delivery. In the

meantime, a veteran's condition can change or the veteran may die (i.e. veterans with ALS). A chair no longer beneficial to one veteran may benefit another, and eliminate the months of waiting. While the VHA does refurbish and reissue wheelchairs, this study found this process is not being well tracked by the NPPD, suggesting the process itself, which could improve the quality of care to veterans and save dollars, needs further investigation.

Another suggestion to improve the effectiveness of the NPPD for research thus the generation of data to support policy decisions is to include the diagnosis for which the WMD is being prescribed in the NPPD.

In closing, consistency in the decision process in which clinicians engage when prescribing a wheelchair is important to the continuum of care of veterans. A database is only as valid as the data that is input. The value of availability of quality training for clinicians working in seating and mobility cannot be underestimated. Alternatively, the market will be driven by manufacturers and vendors [9].

2.7 CONCLUSION

This was the first large-scale study to look at the types of wheelchairs prescribed in the context of disability. The findings were strongly suggestive of disparity in how wheelchairs are provided to veterans and that the standard of care for the provision of wheeled mobility devices within the VHA is not of the same quality as in other populations.

The results of this study indicate Caucasians were more likely than Hispanics and African Americans to receive power wheelchairs. Caucasians were more likely than minorities (Hispanics, African Americans, Asians and American Indians) to receive

scooters and less likely to receive standard, depot wheelchairs. Site level analyses need to be completed to further investigate these findings.

Within the veteran population, the wheelchair most frequently prescribed wheelchair for all diagnoses was a standard or depot wheelchair. For veterans with SCI receiving services from the VHA, 13% received ultralight manual wheelchairs in comparison to 97% of clients with SCI receiving services from Model Spinal Cord Injury Centers [47].

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3 CHAPTER THREE

WHEELCHAIRS AND COST

Veterans Health Administration Costs in Providing Wheeled Mobility Devices

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3.1 ABSTRACT

The purpose of this study was to examine the costs of wheelchair and scooter, per HCPCS code, for geographic and supplier variation. Using a cross-sectional, retrospective, study design, two years of data from the VHA National Prosthetic Patient Database (113,724 records) were analyzed. Due to the distribution of the cost data, descriptive statistics (median costs) were used to identify high median costs. A high median threshold (national median times 2) was calculated for each HCPCS code. The percentage of HCPCS codes with median costs exceeding the threshold ranged from 0% to 17% across Veteran Integrated Service Networks Veteran Integrated Service Networks (VISNs). The percentage of the top 100 vendors (by cost volume) with median costs exceeding the threshold ranged from 2% to 19% for the top 20 HCPCS codes (by frequency volume). During FY00 and FY01, the Veterans Health Administration (VHA) provided over 131,000 wheelchairs and scooters, at a cost of \$109,010,198. Of this \$109 million, \$7,747,405 exceeded an established threshold, and is considered potential excessive cost.

3.2 INTRODUCTION

A Veterans Health Administration (VHA) preliminary report on the top total dollar cost prosthetic items (Fred Downs, Chief Consultant, Prosthetic and Sensory Aid Service, written communication, November, 2000) indicated for the first three quarters of 2000, scooters were the second highest spending total, manual wheelchairs the third highest spending total, and power wheelchairs the fifth, (oxygen equipment was the first). For these three quarters, well over 40,000 wheelchairs (manual wheelchairs, power wheelchairs, and scooters), were issued at a government cost of over 20 million dollars.

The VA, as does any institutional purchaser, seeks to obtain goods at a fair market price, commensurate with quality and with the discounts normally associated with high purchase volumes. However, “assistive devices, like pharmaceuticals, have eluded intensive analysis that adequately addresses fair market pricing” [1] due, according to Render et. al, to lacking assistive technology (AT) expertise outside of the industry, lack of expert review of prescription practices, and inconsistencies in billing and reimbursement.

These shortcomings have led to opportunities for fraudulent billings. Fraudulent power wheelchair scams are the fastest growing scam in Medicare [2]. DME scams in California are at the center of what one Federal Bureau of Investigation (FBI) field office is calling the largest healthcare undercover fraud investigation in U.S. history. The FBI in California have charged 263 DME providers who allegedly have collected \$164 million in fraudulent claims against the state’s Medicaid program, Medi-Cal [3]. In Miami, \$14 million in false claims were submitted over several years [4]. The FBI believes one out of 10 DME, prosthetics, orthotics, and supply providers is a “crook” (sic) [5]. In response to

the increasing volume of fraudulent billing, the Center for Medicare and Medicaid Services (CMS) announced “stringent efforts aimed at stopping abuse of the power wheelchair benefit” [6, 7]. Like Medicare, the VHA is vulnerable to DME fraud. In fact, a DME company uncovered a plan to fabricate \$30 million in non-existent sales of DME to the VHA by one of their consultants [8]. In response, payors have fought back by applying more stringent interpretations of durable medical equipment (DME) policy. Unfortunately, this tactic punishes consumers with legitimate needs.

The National Patient Prosthetics Database (NPPD) was developed by the VHA Prosthetics and Sensory Aids Service (PSAS) to track WMD and other prosthetic expenditures. In addition, the NPPD provides an opportunity to review prescription practices between clinical teams, facilities, and Veteran Integrated Service Networks (VISNS). For over 50 years, wheeled mobility prescriptions have been written by multiple clinical services and teams in each of the 172 VHA medical centers with little contact between centers (Fred Downs, Chief Consultant, Prosthetic and Sensory Aid Service, written communication, December 2000). Today, not only is the demand for WMDS increasing [9-13], technology is changing rapidly. As wheelchair technology becomes increasingly more sophisticated and complex, so do the clinical decision processes as to who gets what device. Thus, the question that comes to mind is: Are there variations in cost of WMDS provided by the VHA and if so, do these variations reflect varying prescription practices that may ultimately affect the quality of care provided to veterans?

The objective of this study was to use NPPD data to investigate whether the expenditures for wheeled mobility devices (WMD), or wheelchairs and scooters, varied

geographically or by vendor. The first question asked if WMD costs at the Veteran Integrated Service Network (VISN) [14] level differed from the national median. The second research question asked if WMD costs varied by vendor. The answer to these questions can guide VA policy makers toward more enlightened decisions than merely "tightening the noose" as other payors have done.

3.3 METHODS

3.3.1 Design and Data Source

This study was approved by the VA Pittsburgh Healthcare System Institutional Review Board. A cross-sectional, retrospective, design used two years of data from the NPPD, extracting the records of veterans who received wheelchairs or scooters from the VHA during FY00 or FY01. NPPD data, housed at the VA Information Resource Center (VIREC) [15] at Hines, IL.

3.3.2 Database Description

NPPD: The NPPD contains information on every device issued to veterans including the description of the device, prescribing station and VISN, type of service (initial issue, replacement, spare, or repair), date, cost, and vendor. The fields used for this study were "VISN", "cost", "createdate", "vendor", "hcpcspas", "nppdline", and "patientid".

3.3.3 Data Cleaning

General NPPD data cleaning was performed according to decision rules developed during a collaborative validity study of the NPPD [16]. A comparison of the frequency counts of the records contained in the "nppdline" and "hcpcspas" fields

determined the “nppdline” field was the most reliable and valid method of selecting the wheelchair and scooter items. The “nppdline” field is a VA code that specifies the type of device. For example, the “100” category represents wheelchairs, “100 A” represents power wheelchairs, “100 B” manual wheelchairs, and “100 C” wheelchair accessories” [17]. The “hcpcspas” field is the Prosthetics and Sensory Aids Services (PSAS) code that corresponds to the CMS HCPCS code. During data cleaning, when inconsistencies between the “nppdline” and “hcpcspas” fields were found, other fields including vendor, cost, and item description were considered, and the record recoded accordingly. For fiscal years (FY) 2000 and 2001, only three WMDs required recoding: a scooter and two manual wheelchairs.

Cost data was further cleaned by excluding 3,799 observations with missing cost values and 5,639 observations with \$0.00 cost values, with 121,774 observations remaining for FY00 and FY01 combined. HCPCS codes with five or less observations over the 2-year study period were excluded (E1085 n=5, E1091 n=1, E1170 n=5, and E1299 n=1) leaving 64 HCPCS codes and 121,762 observations (see following section for definition of HCPCS codes). HCPCS code E1065 (n=161) was also deleted because of inconsistent coding: it was used as a code for scooters, attachments that transform a manual wheelchair to a power wheelchair, and power wheelchairs.

Wheelchair costs that were too low to represent wheelchairs or scooters (assumed to be either accessories or coding error) were excluded (because of the lowering effect they had on mean and median values) leaving 113,724 records. The determination of which low values to exclude was made as follows: Logical high dollar cut-off points were selected based the code and description of the device, market value, and the VHA

contract amount if known. Frequencies were run on each HCPCS code by the cost variable. The cost value at the cumulative frequencies of 10%, 50%, 75%, and 100% were assessed as well as the percent of records excluded at proposed cutoff. See Appendix A for the selected cutoffs per HCPCS code and corresponding frequency information. High cutoff points were not implemented as the purpose of this study was to identify high cost outliers by VISN and by vendor.

The vendor data was also cleaned. Multiple names were used for the same vendor, for example, WHEELCHAIR, Wheelchair, WheelChair, Wheel Chair Inc, WheelChair Inc., and WheelChair/ Inc. were combined if these vendors were also serving the same VISNs, reducing the number of unique vendors from over 1,325 to 696. Devices from VHA PSAS orthotic and prosthetic labs and warehouses were combined so the PSAS could be considered as a cost source. Number of vendors was further limited by excluding vendors with less than five total wheelchair or scooter sales to the VHA leaving 243 vendors and 113,336 records. So results could be presented in a comprehensible manner, data was further reduced to the top 100 vendors (measured in dollars) and the top 20 HCPCS codes (measured in frequency) were extracted leaving 103,833 records to be included in the vendor analysis.

3.3.4 Operational Definitions

HCPCS codes: Wheelchairs and scooters sold in the U.S. must be approved by the Federal Drug Administration (FDA). The FDA forwards information on the wheelchair application to the Center for Medicare and Medicaid Services (CMS). CMS assigns the wheelchair a standard code, referred to as HCPCS (Healthcare Common Procedure Coding System) code designed for billing purposes. HCPCS codes are used to

identify the type of device in the NPPD. Table 19 provides the list of codes included in the clean dataset (prior to exclusion of all but the top 20 HCPCS codes) and typical CMS and NPPD descriptions.

Table 19 HCPCS codes and typical NPPD descriptions

Code	Description
E1050	W/c reclining fxd arms
E1060	W/c detachable arms
E1070	W/c detachable foot r
E1083	Hemi w/c fixed arms
E1084	Hemi w/c detachable a
E1086	Hemi w/c detachable a
E1087	W/c lightwt fixed arm
E1088	W/c lightweight det a
E1089	W/c lightwt fixed arm
E1090	W/c lightweight det a
E1092	W/c wide/w leg rests
E1093	W/c wide/w foot rest
E1100	W/c s-recl fxd arm leg res
E1110	W/c semi-recl detach
E1130	W/c stand det arm ft rest
E1140	W/c standard detach a
E1150	W/c standard w/ leg r
E1160	W/c fixed arms
E1171	W/c amputee w/o leg r
E1172	W/c amputee /detach ar
E1180	W/c amputee w/ foot r
E1190	W/c amputee w/ leg re
E1195	W/c amputee heavy dut
E1200	W/c amputee fixed arm
E1210	W/c motorfxd arm leg rest
E1211	W/c motorized w/ det
E1212	W/c motorized w full
E1213	W/c motorized w/ det
E1220	W/c special size/constrc
E1221	W/c spec size w foot
E1222	W/c spec size w/ leg
E1223	W/c spec size w foot
E1224	W/c spec size w/ leg
E1225	W/c spec sz semi-recl
E1226	W/c spec sz full-recl

Table 19 HCPCS codes and typical NPPD descriptions

E1227	W/c spec spec sz spec ht A
E1228	W/c spec spec sz spec ht B
E1230	Powered operated vehicle
E1240	W/c litwt det arm leg rest
E1250	W/c lightwt fixed arm
E1260	W/c lightwt foot rest
E1270	W/c lightweight leg r
E1280	W/c h-duty det arm leg res
E1285	W/c heavy duty fixed
E1290	W/c hvy duty detach a
E1295	W/c heavy duty fixed
E1296	W/c special seat heig
E1297	W/c special seat dept
E1298	W/c spec seat depth/w
K0001	Standard wheelchair
K0002	Std hemi (low seat) w/c
K0003	Lightweight wheelchair
K0004	High strength ltwt whlchr
K0005	Ultralightweight wheelchair
K0006	Heavy duty wheelchair
K0007	Extra heavy duty wheelchair
K0008	Custom manual wheelchair/base
K0009	Other manual wheelchair base
K0010	Std wt frame power w/c
K0011	Std wt pwr whlchr w control
K0012	Ltwt portbl power whlchr
K0013	Custom motorized/power wheelchair base
K0014	Other power whlchr base

Cost: Cost was determined by summing wheelchairs and wheelchair components as follows. Veterans with more than one record per fiscal year were identified. These records were then grouped by veteran and sorted by the date the record was created (variable = “createdate”), which according to PSAS policy must be within five days of prescription. Using the “nppdline” variable, wheelchairs were coded as “1” and wheelchair components (such as seating systems, removable armrest not included in the price of the chair) were coded as “2”. All wheelchairs (code=1) were included in cost calculations. Wheelchair components (code=2) were added to the cost of the wheelchair

if their “createdate” was within 20 days (plus or minus 10 days) of the “createdate”. If the component “createdate” was not within 20 days of a wheelchair “createdate”, the record was not considered part of the wheelchair purchase and was excluded. If the component “createdate” was within 20 days of more than one wheelchair “createdate”, it was included into the cost of the wheelchair with the nearest “createdate”. If there were more than one wheelchair with the same “createdate” as the component “createdate”, the component was included in the cost of the first wheelchair listed with matching “createdate”.

According to VHA policy, a WMD order has to be entered into the system within five days of prescription. Initially the window set at five-days from the date the device was entered, based on the assumption that a component would not likely be ordered prior to the device itself. This assumption proved false. Based on examination of the data, the window was extended to capture components entered 10 days prior and 10 days post entering the device into the system.

VISN: There are approximately 1127 VHA facilities [14] nationally which are organized according to 22 Veteran Integrated Service Networks (VISNS). A VISN may include more than one state (i.e. in New England), or for large states (i.e. Texas) there may be more than one VISN per state. In this study, VISNS were used as the geographical unit of comparison, as it is the geographical unit used in all the VHA databases.

Vendor: The “vendor” field of the NPPD is a text description of the company that provided the device [15].

3.4 ANALYSES

SAS® [18] software was used for all analyses. The distribution of the clean dataset (low values excluded) was extremely skewed and could not be normalized with a log transformation. Thus, descriptive statistics, median values, were used to answer question 1, whether cost varied by VISN, and question 2, whether cost varied by vendor. More specifically, the investigators were interested in high dollar costs. To identify the high dollar costs, a threshold was calculated for each HCPCS code as follows: the median cost for each HCPCS code $\times 2 =$ high median threshold. The high median threshold was then subtracted from the cost of the device. The remainder, if positive, was the amount exceeding the high median threshold.

To answer the first research question, records with costs exceeding the high median threshold were sorted by VISN. For each VISN, HCPCS codes with median values exceeding the high median threshold were identified and displayed in table format. The high cost variation was then quantified by identifying all records with cost exceeding the high median threshold, then summing the excessive costs per VISN.

A similar procedure was used to answer the second research question. Records with costs exceeding the high median threshold were sorted by vendor. For the top 100 vendors (as described in data cleaning), HCPCS codes with median values exceeding the high median threshold were identified and displayed in table format. The variation was then quantified by identifying all records with cost exceeding the high median threshold, then summing the excessive costs by vendor.

3.5 RESULTS

The answer to both research questions was yes, variation in the cost of WMD among VISNs and among vendors exists. A conservative approach was used to calculate HCPCS high median cost thresholds (national median for each HCPCS times 2) to identify variance. For each HCPCS code, the national median, the high median threshold, and VISN median costs that exceed the threshold, are displayed in Tables 20 – 23. Table 20 displays the high median values per HCPCS code for VISN 1 – 7. Table 21 displays the high cost median values for VISN 8 – 14, and Table 22 the high cost values for VISN 15 – 22. The percentage of HCPCS codes with median costs exceeding the threshold ranged from 0% to 17% across VISNs. A limitation to median values is they do not reflect the high excess costs. Thus the dollar amount each VISN exceeded the high median cost threshold was calculated as follows: for all records the threshold was subtracted from the device cost. Positive results (greater than 0) were summed and the totals displayed in Table 23.

VISN 13 had no HCPCS median values that were over the threshold. However, VISN 13 did have individual records that exceeded the threshold, totaling over \$100,000. The total dollar amounts VISNs were over the threshold ranged from \$102,000 (VISN 13) to \$903,000 (VISN 16). While only 12% of the VISN 16 HCPCS median values that were over the threshold, VISN 16 had the highest frequency and dollar amount of individual devices with costs that exceeded the thresholds. The total dollar amount exceeding HCPCS thresholds, for all VISNS, was \$7,747,405 (data not presented in a table)³. The \$7.7 million dollar excess cost represents approximately 7% of the \$109 million dollar VHA expenditure for wheelchairs and scooters during FY00 and FY01.

For each HCPCS code, the national median, the high median threshold, and vendor median costs that exceed the threshold, are displayed in Tables 24 – 27. In order to present the results in a more concise manner, only median value results for the top 100 vendors and top 20 HCPCS codes (as described in “Data Cleaning”) are presented. Table 24 displays the high median values per HCPCS code for the five highest volume (16-20/20) HCPCS codes: K0001, K0004, E1230, K0003, and K0005. Table 25 displays the next highest volume (11-15/20) HCPCS codes: K0011, E1140, K0006, K0014, and E1150. Table 26 displays the third highest volume (6-10/20) HCPCS codes: K0007, E1211, E1260, E1212, and E1088. Table 27 high median values per HCPCS code for the lowest volume (1-5/20) HCPCS codes: K0008, E1070, E1060, K0010, and K0012.

As an example of how to read and interpret these tables, Table 24 contains one of the highest volume HCPCS codes, the K0004, a lightweight manual rehabilitation wheelchair with a national median cost of \$362 and a high median threshold of \$723. For the K0004, 13 vendors had excess median costs totaling \$172,562 for 266 wheelchairs, with an average of \$649 per chair over the \$723 threshold. While 13 of the top 100 volume vendors (13%) had median costs exceeding the threshold for the K0004, the percent of vendors with median costs exceeding the threshold ranged from 2% to 19% across the top 20 HCPCS codes.

Table 20 VISN 1 – 7 high median costs: VISN median costs higher than national median costs per HCPCS code for FY00 & FY01 combined

VISN Median Costs Over the High Median Cost Threshold (National Median x 2) for VISNS 1 - 7																	
HCPCS Code	NATIONAL			VISN 1		VISN 2		VISN 3		VISN 4		VISN 5		VISN 6		VISN 7	
	n	median	high median \$ threshold	n	median												
Manual																	
E1050	75	\$392	\$784	4	\$1,076												
E1060	910	\$370	\$740					12	\$990								
E1070	976	\$178	\$356	17	\$446	4	\$418	16	\$365								
E1084	53	\$436	\$872					2	\$996								
E1086	44	\$387	\$774			1	\$3,015										
E1110	250	\$709	\$1,418			10	\$1,531					7	\$1,560				
E1130	563	\$156	\$312	7	\$450					51	\$487						
E1140	2441	\$170	\$340	14	\$468					55	\$436						
E1150	1384	\$211	\$422											8	\$426	2	\$579
E1160	138	\$166	\$332	2	\$1,125	3	\$1,007							1	\$340		
E1171	24	\$455	\$910							1	\$1,863					2	\$1,125
E1172	119	\$351	\$702	1	\$1,469			2	\$709					7	\$749		
E1180	82	\$379	\$758									1	\$845				
E1190	164	\$237	\$474							6	\$800	4	\$481	4	\$844	2	\$504
E1195	47	\$626	\$1,252	2	\$1,951	4	\$1,971									1	\$1,700
E1200	47	\$145	\$290							5	\$1,011	1	\$516	1	\$386		
E1220	208	\$1,126	\$2,252									6	\$1,729			12	\$1,764
E1221	125	\$696	\$1,392			1	\$1,791										
E1223	254	\$182	\$364			1	\$1,117	1	\$981					1	\$371	1	\$1,669
E1224	20	\$405	\$810											2	\$1,713		
E1226	240	\$497	\$994			1	\$1,874	5	\$1,913	1	\$1,854	6	\$1,409				
E1228	25	\$349	\$698	2	\$1,086												
E1240	316	\$411	\$822	1	\$844			2	\$878								
E1260	830	\$292	\$584											1	\$1,435		
E1280	152	\$596	\$1,192													92	\$1,614
E1296	67	\$421	\$842			6	\$1,056							4	\$866		
E1298	166	\$788	\$1,576											1	\$1,755		
K0002	459	\$359	\$718	3	\$2,217									2	\$733		
K0007	1322	\$496	\$992	40	\$1,143												
K0009	668	\$661	\$1,322									18	\$1,799				

Table 21 VISN 8-14 high median costs: VISN median costs higher than national median costs per HCPCS code for FY00 & FY01 combined

VISN Median Costs Over the High Median Cost Threshold (National Median x 2) for VISNS 8 - 14																	
HCPCS Code	NATIONAL			VISN 8		VISN 9		VISN 10		VISN 11		VISN 12		VISN 13		VISN 14	
	n	median	high median \$ threshold	n	median	n	median	n	median	n	median	n	median	n	median	n	median
Manual																	
E1050	75	\$392	\$784									3	\$810			1	\$1,905
E1070	976	\$178	\$356	24	\$515							26	\$451				
E1087	115	\$444	\$888					1	\$1,483								
E1089	58	\$588	\$1,176			1	\$1,531										
E1090	461	\$570	\$1,140													1	\$1,244
E1093	74	\$376	\$752							1	\$2,700						
E1100	73	\$640	\$1,280			3	\$1,374										
E1130	563	\$156	\$312			1	\$380										
E1140	2441	\$170	\$340									5	\$410			4	\$386
E1150	1384	\$211	\$422									3	\$423				
E1190	164	\$237	\$474									2	\$497				
E1200	47	\$145	\$290									2	\$331				
E1221	125	\$696	\$1,392									1	\$9,053				
E1228	25	\$349	\$698					2	\$1,141								
E1240	316	\$411	\$822			1	\$997										
E1250	53	\$452	\$904	1	\$1,578												
E1290	503	\$573	\$1,146													7	\$1,580
E1295	61	\$622	\$1,244			1	\$1,364									1	\$1,351
E1297	44	\$320	\$640	2	\$1,899					1	\$1,002						
K0007	1322	\$496	\$992													35	\$993

Table 22 VISN 15-22 high median costs: VISN median costs higher than national median costs per HCPCS code for FY00 & FY01 combined

VISN Median Costs Over the High Median Cost Threshold (National Median x 2) for VISNS 15 - 22																			
HCPCS Code	NATIONAL			VISN 15		VISN 16		VISN 17		VISN 18		VISN 19		VISN 20		VISN 21		VISN 22	
	n	median	high median \$ threshold	n	median														
Manual																			
E1050	75	\$392	\$784									3	\$1,141					3	\$1,660
E1060	910	\$370	\$740					2	\$1,772					1	\$1,125				
E1087	115	\$444	\$888					3	\$1,400			1	\$1,000						
E1088	1068	\$455	\$910													25	\$922		
E1089	58	\$588	\$1,176					1	\$2,593									1	\$4,778
E1090	461	\$570	\$1,140					1	\$1,174									16	\$1,168
E1092	69	\$382	\$764											1	\$1,322				
E1100	73	\$640	\$1,280							1	\$2,165	1	\$1,726					2	\$1,294
E1130	563	\$156	\$312									56	\$388			2	\$409		
E1140	2441	\$170	\$340							1	\$549	54	\$415	1	\$560				
E1160	138	\$166	\$332	11	\$522														
E1171	24	\$455	\$910							1	\$1,389								
E1172	119	\$351	\$702			8	\$1,045	1	\$883										
E1180	82	\$379	\$758			3	\$953							1	\$934	1	\$950		
E1190	164	\$237	\$474	7	\$488	3	\$889												
E1195	47	\$626	\$1,252									1	\$1,406					1	\$2,777
E1200	47	\$145	\$290							4	\$1,015	1	\$1,485						
E1220	208	\$1,126	\$2,252					16	\$2,435					7	\$4,280			4	\$2,607
E1221	125	\$696	\$1,392									1	\$1,988						
E1223	254	\$182	\$364	4	\$675	1	\$592					1	\$8,079						
E1225	38	\$1,073	\$2,146	2	\$2,325														
E1228	25	\$349	\$698			2	\$1,214												
E1250	53	\$452	\$904													2	\$1,903	2	\$1,812
E1260	830	\$292	\$584			19	\$682												
E1280	152	\$596	\$1,192															1	\$1,728
E1295	61	\$622	\$1,244													1	\$1,740		
E1296	67	\$421	\$842															3	\$1,622
E1297	44	\$320	\$640	1	\$756	7	\$869												
E1298	166	\$788	\$1,576													1	\$4,697		
K0002	459	\$359	\$718											2	\$1,018			8	\$828
K0007	1322	\$496	\$992					6	\$1,615									17	\$1,354
K0009	668	\$661	\$1,322					12	\$1,343			18	\$1,867	8	\$1,815	15	\$1,357		
Power																			
E1213	363	\$3,599	\$7,198													2	\$7,384		
K0012	748	\$1,993	\$3,986			16	\$4,204					3	\$4,683						

Table 23 Total dollar amount each VISN is over the high cost threshold

Total \$ Amount Individual Observations Exceed National Median X 2 Threshold by VISN				
	% of medians exceeding nat'l median	Sum n	\$ exceeding nat'l medianx2 threshold †	
VISN	1	17%	93	\$58,254
	2	14%	31	\$68,897
	3	11%	40	\$69,754
	4	9%	119	\$215,799
	5	12%	45	\$45,187
	6	15%	30	\$89,080
	7	11%	112	\$141,258
	8	9%	27	\$118,991
	9	7%	7	\$27,459
	10	3%	3	\$52,418
	11	3%	2	\$55,007
	12	11%	42	\$48,712
	13	0%	0	\$34,516
	14	9%	49	\$23,717
	15	7%	25	\$169,348
	16	12%	43	\$211,674
	17	12%	42	\$108,041
	18	6%	7	\$57,665
	19	15%	119	\$60,151
	20	11%	21	\$41,087
	21	14%	64	\$72,634
	22	15%	41	\$117,670
TOTAL		2727	\$1,887,318	

†formula:
Sum (COST-High Median \$ Threhold (Nat'l medianx2))

Table 24 Dollar amount over cutoff: high volume vendors and 15-20/20 highest volume HCPCS codes for FY00 and FY01 combined

Top Vendors by Cost Volume	Top 15-20 of Top 20 HCPCS Codes per Frequency Volume																	
	K0001			K0004			E1230			K0003			K0005					
	Nat'l Median \$ by HCPCS			\$163			\$362			\$1,935			\$356			\$1,067		
	Nat'l Median \$ x 2 Threshold			\$326			\$723			\$3,870			\$712			\$2,133		
	n	cost	\$over threshold	n	cost	\$over threshold	n	cost	\$over threshold	n	cost	\$over threshold	n	cost	\$over threshold			
21ST CENTURY SCIENTIFIC						1	\$5,638	\$1,768	1	\$3,562	\$2,850							
ACCESS AND MOBILITY PROD	1	\$255	\$72															
ACTION MEDICAL EQUIP & SUPPLY	8	\$368	\$42															
ADVANCED MEDICAL CONCEPT				23	\$1,445	\$721	5	\$5,595	\$1,725									
C W HEALTHCARE	7	\$1,047	\$721															
CENTRAL ALABAMA MOBILITY	1	\$493	\$167															
CENTRAL OHIO WHEELCHAIR	1	\$970	\$644	1	\$1,180	\$456												
CHESAPEAKE REHAB EQUIP	1	\$2,789	\$2,463									1	\$2,534	\$401				
CHOICE MOBILITY				1	\$2,858	\$2,134												
ECONOMY MEDICAL	1	\$2,789	\$2,463															
EQUIPMENT COMPANY UNLIMIT				2	\$2,579	\$1,855						1	\$2,183	\$50				
FASTSERV MEDICAL	1	\$385	\$59															
GUARDIAN PRODUCTS				71	\$1,102	\$378				40	\$1,032	\$320						
GULF COAST REHAB EQUIPMENT	1	\$725	\$399															
HEALTHCARE EQUIPMENT				22	\$1,444	\$720												
HOVEROUND CORP							12	\$4,647	\$777									
KLINGENSMITH HEALTH CARE							7	\$4,725	\$855	1	\$868	\$156						
KWIK KARE INC	4	\$850	\$524	75	\$841	\$117				4	\$1,010	\$298						
LABAC SYSTEMS INC				4	\$2,306	\$1,582							1	\$2,677	\$544			
LEVO USA INC				1	\$5,806	\$5,082				1	\$4,103	\$3,391	2	\$5,786	\$3,653			
MEDBLOC INC	1	\$2,462	\$2,136	1	\$2,157	\$1,433				2	\$2,107	\$1,395						
MIDSTATE MEDICAL SVC	11	\$390	\$64															

Table 24 Dollar amount over cutoff: high volume vendors and 15-20/20 highest volume HCPCS codes for FY00 and FY01 combined

	Top 15-20 of Top 20 HCPCS Codes per Frequency Volume																	
	K0001			K0004			E1230			K0003			K0005					
	Nat'l Median \$ by HCPCS			\$163			\$362			\$1,935			\$356			\$1,067		
	Nat'l Median \$ x 2 Threshold			\$326			\$723			\$3,870			\$712			\$2,133		
Top Vendors by Cost Volume	n	median	\$over	n	median	\$over	n	median	\$over	n	median	\$over	n	median	\$over			
		cost	threshold		cost	threshold		cost	threshold		cost	threshold		cost	threshold			
MOBILE HELP	1	\$2,447	\$2,121															
OTTO BOCK ORTHOPEDIC	4	\$557	\$231	3	\$1,925	\$1,201				2	\$810	\$98						
PERMOBIL INC	2	\$1,614	\$1,288	10	\$1,877	\$1,153	3	\$13,500	\$9,630	5	\$1,537	\$825						
PRIDE HEALTH CARE INC				2	\$2,750	\$2,026				2	\$3,568	\$2,856						
SS MEDICAL/ INC.	26	\$648	\$322	1	\$775	\$51				7	\$830	\$118						
TI SPORT	3	\$2,196	\$1,870	21	\$2,310	\$1,586				23	\$2,213	\$1,501	65	\$2,312	\$179			
TOP END INC	2	\$998	\$672	13	\$1,973	\$1,249				30	\$1,601	\$889						
WHEELCARE INC										1	\$849	\$137						
WHEELCHAIR&SCOOT EXPRES				1	\$1,589	\$865				1	\$980	\$268						
WHEELCHAIR INSTIT OF KANSAS	13	\$1,914	\$1,588	2	\$3,128	\$2,404	1	\$8,699	\$4,829	2	\$1,610	\$898						

Table 25 Dollar amount over cutoff: high volume vendors and 10-15/20 highest volume HCPCS codes for FY00 and FY01 combined

Top Vendors by Cost Volume	Top 10-15 of Top 20 HCPCS Codes per Frequency Volume														
	K0011			E1140			K0006			K0014			E1150		
	Nat'l Median \$ by HCPCS														
	Nat'l Median \$ x 2 Threshold														
	medn	\$over		medn	\$over		medn	\$over		medn	\$over		medn	\$over	
	n	cost	threshold	n	cost	threshold	n	cost	threshold	n	cost	threshold	n	cost	threshold
21ST CENTURY SCIENTIFIC	6	\$8,539	\$746							10	\$9,214	\$206			
ADVANCED MEDICAL CONCEPT							1	\$1,302	\$402						
ALL ACTIVE MOBILITY							1	\$6,240	\$5,340						
AMERICAN MED EQUIP&SERV							3	\$990	\$90						
CHESAPEAKE REHAB EQUIP				3	\$436	\$96							36	\$441	\$19
ELECTRIC THREE WHEELER							1	\$4,022	\$3,122						
EQUIPMENT CO UMLIMIT	1	\$11,724	\$3,931												
EVEREST & JENNINGS							154	\$1,027	\$127						
FALCON REHAB PROD										4	\$10,963	\$1,955			
KLINGENSMITH HEALTH CARE				1	\$476	\$136							4	\$655	\$233
KWIK KARE INC							3	\$2,000	\$1,100						
LABAC SYSTEMS INC							2	\$1,781	\$881						
LEVO USA INC										1	\$10,475	\$1,467			
MEDBLOC INC							2	\$2,057	\$1,157						
MOBILE HELP							1	\$5,050	\$4,150						
PERMOBIL INC	13	\$12,463	\$4,670							40	\$12,901	\$3,893			
REDMAN POWER CHAIR LLC										2	\$18,328	\$9,320			
SUNRISE MEDICAL INC							99	\$911	\$11						
SUPPLY WAREHOUSE				136	\$410	\$70									
TD COMPLETE MEDICAL										2	\$18,784	\$9,776			
TEFTEC CORP	6	\$17,459	\$9,666												
WHEELCHAIR&SCOOT EXPRES				3	\$1,250	\$910									
WHEELCHAIR INSTIT OF KANSAS							30	\$1,806	\$906						

Table 26 Dollar amount over cutoff: high volume vendors and 5-10/20 highest volume HCPCS codes for FY00 and FY01 combined

	Top 5-10 of Top 20 HCPCS Codes per Frequency Volume																
	K0007			E1211			E1260			E1212			E1088				
	Nat'l Median \$ by HCPCS			Nat'l Median \$ x 2 Threshold			Nat'l Median \$ by HCPCS			Nat'l Median \$ x 2 Threshold			Nat'l Median \$ by HCPCS			Nat'l Median \$ x 2 Threshold	
	n	medn cost	\$over threshold	n	medn cost	\$over threshold	n	medn cost	\$over threshold	n	medn cost	\$over threshold	n	medn cost	\$over threshold		
21ST CENTURY SCIENTIFIC				7	\$9,785	\$2,177	1			7	\$9,785	\$1,385					
AMIGO MOBILITY							2	\$2,217	\$1,729								
C W HEALTHCARE	7	\$1,140	\$148										3	\$2,265	\$1,355		
CHESAPEAKE REHAB EQUIP																	
EVEREST & JENNINGS	169	\$1,405	\$413										3	\$1,046	\$136		
GUARDIAN PRODUCTS													13	\$1,276	\$366		
GULF COAST REHAB EQUIPMENT							1	\$1,195	\$707				2	\$5,318	\$4,408		
HEALTHCARE EQUIPMENT	3	\$1,755	\$763														
LABAC SYSTEMS INC	1	\$2,560	\$1,568														
OTTO BOCK ORTHOPEDIC	1	\$2,055	\$1,063														
PERMOBIL INC				21	\$12,143	\$4,535				21	\$12,143	\$3,743					
SENIOR NOTES INC													1	\$1,252	\$342		
SUNRISE MEDICAL INC	43	\$1,205	\$213														
TEFTEC CORP				6	\$16,205	\$8,597				6	\$16,205	\$7,805					
TI SPORT							1	\$2,237	\$1,749				10	\$2,356	\$1,446		
TOP END INC							1	\$2,149	\$1,661				1	\$1,706	\$796		
WHEELCHAIR & SCOOTER EXPRES	1	\$3,436	\$2,444				2	\$1,065	\$577				1	\$2,680	\$1,770		
WHEELCHAIR INSTIT OF KANSAS	51	\$2,087	\$1,095														

Table 27 Dollar amount over cutoff: high volume vendors and 1 - 5/20 highest volume HCPCS codes for FY00 and FY01 combined

Nat'l Median \$ by HCPCS Nat'l Median \$ x 2 Threshold	Top 1-5 of Top 20 HCPCS Codes per Frequency Volume														
	K0008			E1070			E1060			K0010			K0012		
	\$917			\$178			\$370			\$2,932			\$1,993		
	\$1,835			\$356			\$740			\$5,864			\$3,987		
Top Vendors by Cost Volume	n	medn cost	\$over threshold	n	medn cost	\$over threshold	n	medn cost	\$over threshold	n	medn cost	\$over threshold	n	medn cost	\$over threshold
21ST CENTURY SCIENTIFIC													1	\$10,808	\$6,821
ADVANCED MEDICAL CONCEPT	3	\$2,199	\$364							2	\$13,971	\$8,107			
AMERICAN MEDICAL EQUIP&SERV				2	\$524	\$168	1	\$1,299	\$559						
AMIGO MOBILITY	1	\$2,130	\$295				2	\$925	\$185						
C W HEALTHCARE															
CHOICE MOBILITY										4	\$6,343	\$479			
ELECTRIC 3 WHEELERS INC													1	\$4,103	\$116
ELECTRIC MOBILITY CORP	1	\$2,302	\$467												
EVEREST & JENNINGS				54	\$473	\$117									
FRONTIER ACCESS&MOBILITY													1	\$4,875	\$888
GUARDIAN PRODUCTS													1	\$5,242	\$1,255
GULF COAST REHAB EQUIPMENT	1	\$8,339	\$6,504												
HOVEROUND CORP													1	\$6,116	\$2,129
KLINGENSMITH HEALTH CARE							58	\$818	\$78						
LABAC SYSTEMS INC	5	\$2,974	\$1,139												
LEVO USA INC	3	\$4,551	\$2,716												
MEDBLOC INC													2	\$5,454	\$1,467
MEDICAL HOME CARE INC				2	\$620	\$264							2	\$4,043	\$56
MOBILITY KING													1	\$4,200	\$213
MOBILITY PLUS INC				1	\$484	\$128									
OTTO BOCK ORTHOPEDIC	1	\$2,340	\$505												
PERMOBIL INC										2	\$12,336	\$6,472	2	\$11,325	\$7,338
PRIDE HEALTH CARE INC	4	\$3,523	\$1,688												
REDMAN POWER CHAIR LLC										1	\$15,965	\$10,101			
SUNRISE MEDICAL INC				45	\$868	\$512	47	\$974	\$234						
TI SPORT	12	\$2,181	\$346												
TOP END INC							2	\$1,998	\$1,258						
TRAVIS MEDICAL SALES CORP										1	\$8,243	\$2,379			
WHEELCHAIR & SCOOTER EXPRES				1	\$537	\$181				1	\$8,243	\$2,379			
WHEELCHAIR INSTIT OF KANSAS	5	\$2,120	\$285										1	\$4,009	\$22

3.6 DISCUSSION

Nationally, the VHA purchased over 131 million wheelchairs and scooters at a cost of approximately \$109 million during FY00 and FY01. When these cost data were adjusted for wheelchair components, i.e. wheelchairs and associated wheelchair components, such as arm rests or seating systems were summed (see Methods/ Operational Definitions/ Cost), the dollars spent increased by 2 million dollars in FY00 and nearly 2.5 million in FY01. The objective of this study was to compare VHA WMD expenditures across VISNS and vendors to identify variation and potential excessive costs.

The results of this study suggest variation in cost by VISN and by vendor exist. At least part of this variation is attributed to lack of standardization of prosthetic purchase procedures and data entry within the VHA. Another consideration is the possibility of fraud and abuse, which merits further investigation, but was beyond the scope of this study.

The cost data were not normally distributed and were extremely skewed by both low and high median costs. Low cost outliers were excluded from the dataset as a method of cleaning the data for error and known coding inconsistencies and because of the lowering effect low values had on median values. High cost outliers were not excluded, as an objective of this study was to identify and describe high cost outliers in an effort to further validate NPPD cost data [16].

Low Cost Outliers: There are several explanations for low cost outliers: wheelchair components were coded as wheelchairs, refurbished wheelchairs had costs ranging from \$0.00 to half the purchase price, and data entry error. The data entry error is

self-explanatory. Re-furbished WMDs are devices that were returned to the VHA by one veteran for redistribution to another. VHA policy states “whenever possible, reclaimed wheelchair that have been restored will be re-issued” (1173.6)[19]. Initially, policy stated the cost entered for re-issued devices was \$0.00, resulting in 5199 \$0.00 entries in FY00. The policy then changed: refurbished wheelchairs were to be assigned a value equal to half their original cost. In FY01 there were only 440 \$0.00 entries. Implementation of this change in policy is based on the assumption that the data entry person has access to the original purchase record of the device from which to determine half of its value.

A third explanation for low cost outliers was inconsistency in coding. Wheelchair components were frequently coded as the wheelchair they complemented rather than as the component itself. For example, one veteran may have 10 “K0010” HCPCS codes all with the same “createdate” associated with his “patientid” suggesting prescription of 10 power wheelchairs in one day. Upon examination of the “cost” and text “description” fields, the veteran actually received one power wheelchair and nine related components, such as leg rests, etc. Coding inconsistencies can inflate the count of wheelchairs provided by the VHA. Scooters, which usually do not have components, are less likely to be effected.

Coding of Wheeled Mobility Devices: Coding a component as a component versus the device it accompanies was but one of the inconsistencies. The number of HCPCS codes used was also inconsistent. The prescribed device in the previous example could also have been entered as one record: i.e. HCPCS = K0010 with one cost for the complete power wheelchair, with all components, delivery, and set-up included in that price. This same device could have been entered as one wheelchair code (i.e. K0010) and separate

HCPCS codes for the components, battery, battery charger, delivery, and set-up. In a comparison study of VHA and Medicare AT expenditures, Render et. al [1] concluded the non-standardization of data entry made cost comparison difficult, noting that vendors may bill for as many as seven HCPCS codes.

The study described herein did not include power wheelchair batteries and battery chargers in the data analysis because in the NPPD they are coded as “medical equipment” rather than as “wheelchairs/scooters”, thus difficult to systematically separate from other types of batteries and miscellaneous medical equipment. HCPCS codes used for delivery and set up were occasionally found but did not appear to be used in a systematic manner.

Further contributing to the inconsistencies in coding are the many combinations of purchasing options available to VHA facilities: purchase from vendors, purchase directly from manufacturers, maintaining a stock, and employing a seating and mobility specialist. Each of these options can produce a different wheelchair cost. For example, a wheelchair from a facility that stocks a basic lightweight rehabilitation wheelchair, and employs a technician to fit the arm and leg rests may be less expensive than the same wheelchair fitted by the manufacturer, because the NPPD does not reflect the Veterans Affairs Medical Center (VAMC) costs in employing a technician. In this same example, if the manufacturer fits the wheelchair, the cost could be entered as one line item (leg and arm rests included in the cost of the device), as two line items (arm rests included in the cost of the device and leg rests itemized separately), or as three line items (leg and arm rests itemized separately from the cost of the device), as previously discussed. While the flexibility of having multiple purchase options is not only a plus but unique to the VHA, the cost effectiveness of each needs to be determined.

High Cost Outliers: Zero-cost values and costs too low to be attributed to a wheelchair were contrasted by extreme cost entries. For example there was a cost of \$9,000 for a standard “depot” manual wheelchair that typically retails for \$200 to \$400, and can be purchased under VHA contract for \$119 to \$240 fully accessorized (Fred Downs, Chief Consultant, PSAS, written communication, 2003).

Some of the high median cost dollars appeared due to erroneous HCPCS codes. When the three fields, cost, vendor, and code were considered, the cost and vendor fields frequently matched, but the HCPCS code did not. As an example, 21st Century Scientific supplied one scooter (N=1, HCPCS code = E1230) at a cost of \$5,638 with an over the cutoff dollar amount of \$1,768. According to an Internet search, 21st Century Scientific does not manufacture a scooter, but rather high performance power wheelchairs, which would explain the high dollar amount. 21st Century Scientific and “cost” were congruent; the HCPCS code E1230 was not.

As another example, Hoveround had a high median cost for scooters, but for an n=12. Based on an internet search, it was difficult to determine if Hoveround manufactured scooters. A link from the “Google” search engine to the Hoveround corporation web site included “Scooter” in the title of the link but once at the website, scooters were not listed as one of their products. While an Internet battery company provided batteries for Hoveround scooters, a review on a “Tech Guide” website sponsored by the United Spinal Association stated the Hoveround scooter was actually manufactured by Invacare. Of the 51 WMDS were purchased from Hoveround by the VHA (by 14 VISNs), 12 were coded as scooters (E1230) and the remaining as power wheelchairs (E1210, E1211, E1212, E1220, K0010, K0011, K0012, K0013, K0014),

with costs ranging from \$2,318 (high for a scooter) to \$10,551 (reasonable for a custom power wheelchair). Again, Hoveround and “cost” were congruent; the HCPCS code E1230 was not. In the analyses, Hoveround had costs exceeding the threshold for 11 devices, nine of which were scooters. It is likely that the excessive costs for Hoveround can be explained by coding error.

In contrast, Invacare, who holds the VHA competitive bidding contract for depot wheelchairs (K0001) was the vendor with the largest amount of excessive dollars: 43% (1759 devices) of these excess dollars were for depot chairs. The national median was \$163. The cutoff threshold was \$326. This example, with 1,759 instances, is more difficult to attribute to coding error.

There were other manufacturers with high cost apparently due to erroneous HCPCS codes. Many of the codes associated with the high costs were also associated with a wheelchair not manufactured by that particular manufacturer. For example, according to the data presented in Table 25, Labac Systems Inc, had a high median cost for the K0006 (n=2) which is a manual wheelchair. Labac Systems Inc. however, does not manufacture a manual wheelchair. Similarly, Levo USA Inc makes wheelchairs that stand up; Levo does not make a K0003 or K0004. Teftec Corporation only manufactures a K0014, and not a K0011. Ti Sport and Top End Inc. manufacture only K0005, yet had high costs for K0001 and K0004 wheelchairs. All of these are examples of possible coding errors.

For the vendor with the second highest total dollars exceeding the threshold, the most frequent HCPCS codes were K0003 (28%) and K0004 (29%) both lightweight rehabilitation wheelchairs, and K0001 (16%). For vendor with the third highest total

dollars, the most frequent HCPCS codes were K0001 (33%) and K0004 (11%). The vendor with the fourth highest frequency of devices (206 devices) exceeding the threshold, 98% were for the depot wheelchair, K0001.

The vendors that ranked fourth, fifth, and sixth in total dollars exceeding the threshold were primarily power device vendors. It is not surprising for power wheelchairs to exceed the threshold. For example, the national median for a K0014, a custom power wheelchair was \$4,504. The cutoff threshold was \$9,008. It is not uncommon for a custom power wheelchair with features such as tilt in space, recline, and seat elevation to approach a cost of \$20,000, a sum far less than the cost of a surgery to repair a pressure ulcer or to provide skilled nursing for wound management. It is not as easy to explain why a scooter would exceed the \$3,870 threshold as was the case for the vendor ranked fifth in excessive dollars; 49% of this vendor's excess dollars were for scooters (E1230).

One last vendor worthy of mention was the PSAS, or VHA stock: 94% of the excess dollars were for the K0001 depot chair and 80% of these entries were from VISN 6. This finding suggests inconsistent interpretation of VHA policy. Why would a standard wheelchair from VHA stock, a chair that should be purchased via government contract, not only be the most frequent chair to exceed the \$326 threshold, but occur predominantly in one VISN?

Policy Implications: Cost-benefit analysis is fundamental to policy development and implementation. Advances in wheelchair technology and the aging of U.S. veterans will increase the demand for WMDs 6.9% per year through 2007 [9]. WMDs provided by the VHA increased by 6% from FY99 to FY00, and 7% from FY00 to FY01 [20].

The NPPD, developed to provide a better understanding of the relationship

between quality, function, and cost [21], is a valuable and promising source of prosthetic data. Before any cost conclusions can be drawn from analyses of NPPD data, however, the coding must be consistent and reliable. Coding policy should be standardized across VHA facilities.

The HCPCS codes used by the VHA should be current, functional, and consistent with the codes vendors use for other markets. For example, K0002 is a current HCPCS code for a standard wheelchair for an individual with hemiplegia. E1083, E1084, and E1086 are also used by the VHA to designate chairs for individuals with hemiplegia. See Table 29. Four codes used to designate basically the same wheelchair invites error. Multiple E-codes were used by CMS in the 1970s to differentiate whether the chair had fixed, detachable, or swing-away arm-rests for example, with another set of codes to differentiate leg-rests and the combination of arm-leg rests. It is difficult to imagine the usefulness of this information in today's world of customizable (and someday modular) wheelchairs. What is useful is the cost of the finished chair.

Seating systems should be itemized with separate HCPCS codes as they are frequently replaced independently of the wheelchair, or may be retained and transferred to the new chair. Batteries should be included in the cost of power device and coded accordingly, rather than coded with other batteries in the miscellaneous medical equipment category. Set-up and delivery should be itemized in a manner that can be systematically evaluated.

Setup is a particularly important safety factor when providing powered devices with programmable controls to veterans. The purpose of programmable controls is the capacity to adjust responsiveness and speed of the wheelchair to meet the individual

needs of the veteran. Factory settings may be inappropriate. Errors in factory settings can occur, that can cause for example, a chair to drive at excessive speed with only a light touch to the joystick. Manual wheelchairs also require setup. Axle and camber positions and seat and leg/foot rest angles need to be adjusted for each user (for wheelchairs that allow these adjustments) to maximize propulsion efficiency and minimize secondary injuries to the shoulder, elbow, and wrist joints [22-25].

The concept of re-issuing a wheelchair has tremendous cost and time saving implications. It is not unusual for 6 to 18 months to lapse between order and delivery of a custom power or manual wheelchair. During this time, the intended user's motor skills may change. A veteran with amyotrophic lateral sclerosis (ALS), for example, may not be able to use a chair that had been prescribed six months prior. Providing this veteran with an on-hand wheelchair could improve the quality of the veteran's care versus having no chair or an obsolete chair while waiting for the new one.

There is an additional cost benefit: one VHA wheelchair purchase can be used for more than one veteran. Often times, expensive chairs can no longer be used by veterans because of changing needs and abilities. When the chairs remain in good condition, recycling these devices becomes very cost effective. In addition, devices are sometimes prescribed for veterans who do not have progressive conditions but none the less, once the chair arrives, it does not meet the veteran's needs. In a qualitative study of individuals with spinal cord injury, Kittle et. al [16] found participants receiving their first wheelchair (as inpatients) had little insight into their own needs and expectations upon re-entering community life, plus they lacked to ability to learn from other wheelchair users. Their second wheelchair was more satisfactory than the first because they had an

opportunity to realize their wheelchair needs and lifestyle preferences. An ill-prescribed chair for one veteran could be the perfect chair for another.

While the NPPD has potential for tracking dollars saved as a result of re-issuing chairs, it appears to be more of a concept than a reality at this time. It is difficult to identify re-furnished WMDs in the NPPD. The variable “TYPE” includes only “initial issue”, “replacement”, “spare”, and “repair” to chairs. There is a variable “SOURCE” that designates whether a device came from “stock” or from a “commercial source”. At one time devices with a cost of \$0.00 could be inferred to be re-issued chairs, but this policy has changed as discussed earlier. Refinement of the reclaim and reissue system could improve the quality of care for veterans and provide a model for other agencies.

Resources expended to update a DOS-based data entry system like the NPPD, can ultimately save dollars in improved reissue processes and tracking high costs while improving the quality of care of veterans. A windows environment with automated fields, i.e. that prevent a code – vendor mismatch, would be a significant improvement. In addition, the number of possible HCPCS code choices should be consolidated by replacing outdated “E” codes with more current “K” codes. When linked with functional outcomes databases, such as the SF-36V of the 1999 Veterans Health Study [26] and the Functional Status Outcomes Database (FSOD) [17, 27], a valid and reliable cost-benefit analysis could be made.

Many of the high median costs found during this study could be resolved with the standardization of data entry. For others, clinical inquiries may be warranted [21]. Clinical inquiries have been used in the past to resolve counterintuitive data. For

example, an inquiry made into the records of a veteran who received two prosthetic limbs within a seven month period revealed the veteran had lost 68 pounds [21].

Lack of standardization in prosthetic data entry and terminology exchanged between the VHA and the vendor can result in devices delivered to the veteran's home that do not match the script written by the prescribing clinician. It is uncertain as to whether there is a system in place to check whether the correct device was received and if so, whether the device is functional in the veteran's environment. Should these expensive and potentially harmful devices (power wheelchairs and scooters not correctly set-up) be delivered to the veteran's home, or should the clinician have an opportunity to observe the veteran with the device in case the device is incorrect or adjustment is needed. Other considerations include the interaction between operating the device and medications, and transportation of the device. Was the veteran's vehicle taken into consideration when the device was ordered?

Variation in coding can occur at the prescribing clinician level, the vendor level, the government contract website, the data entry person level, the facility level or the VISN level. In at least one VAMC, the clinical team recommends a wheelchair. The prescription is passed along to a vendor, or technician, or directly to the data entry person, thus one translation made. If the vendor, or technician decides how to fill the prescription, this information is then passed on the data entry person for entry into the system, the second translation. For more standard chairs, the data entry person may select a chair from the General Services Administration (GSA) website. Each translation is made by individuals with varying skills and experience with wheelchair design. Typically the device is delivered directly to the veteran's home with no follow-up by the

prescribing clinical team. In essence, current prescription processes may not support the optimal continuum of care for veterans.

Clinical practice guidelines for the prescription of motorized WMDs (written communication, Charles Levy, MD, Gainesville VAMC, July 16, 2004) have been drafted. While these guidelines will assist in the decision making process of providing a manual versus power device, purchase options and device coding need to be standardized before useful feedback can be provided to prescribing clinicians, i.e. as to cost effectiveness and functional outcomes.

Limitations: A foremost limitation to this study was the nature of the data itself. First the distribution of the data was not normal and extremely skewed. While two other studies were found that came to a similar conclusion [1, 16] this study provided more detail on the nature of the high and low outliers, statistical measures that can be taken to normalize the data, and policy recommendation to address the cause of the outliers.

Inconsistent coding of vendors, in addition to inconsistent coding of devices was a persistent problem. Data cleaning efforts were made to consolidate vendors with multiple spellings of their named, i.e. “Wheelchair Inc” and WHEELCHAIR INC’. However questions remained. For example, is “SUPPLY WAREHOUSE” the name of a company, or another phrase for PSAS stock? Vendors with the name of “1” and “DO NOT USE” could not be recoded.

Another limitation of this study was that while administrative databases are useful for cost analyses, they don’t provide information on the functional benefit to the veteran for whom the cost was expended [28]. The NPPD does not provide information on individual veterans, or the circumstances under which the WMD was provided. It is

beyond the scope of the NPPD to reflect whether a high cost custom power chair was more appropriate in meeting the needs of a veteran with significant gross and fine motor impairments than a less expensive chair. Once the parameters of reliability and validity of the NPPD cost data are established, the NPPD can be linked with functional outcomes databases to better determine whether the cost was spent to improve the quality of care and quality of life of veterans.

Future Work: Future studies need to consider case-mix by using a risk-adjustment approach to account for patient characteristics that could significantly influence the type of wheelchair provided [26, 29, 30]. For example, patient's need may vary across VISNS. Northern VISNS are more likely to have a larger population of veterans with multiple sclerosis [31]. Prevalence of stroke is higher in the mid-west and south-east VISNS and the prevalence of COPD highest in the Midwest VISNS with headquarters in Omaha and Kansas City [26]. Diagnosis was found in the study described herein, to effect the type of chair provided.

Studies are planned that expand upon the study described herein to investigate other prosthetics devices such as prosthetic extremities, devices for activities of daily living such as bathing and dressing, and mobility devices such as canes and walkers, and to examine WMD repair data.

It is important to identify and rank the most effective purchase options for WMDs. For example, when are government contracts the best choice and when does a custom device need to be provided. This data is not presently included in the NPPD thus may require a prospective study of high volume sites using various purchase options. An inquiry could be made to determine how many of top 100 vendors have GSA or

competitive bid contracts? Are there cost advantages to maintaining a stock versus purchasing from a vendor or directly or does this depend on the type of device needed?

It would be interesting to know the variance in cost and prescription practices by clinicians who have received training in current in seating and mobility techniques versus those who have not. This would require a study done at the VAMC level versus the VISN level as was this one.

An important outcome is how satisfied veterans are with their devices and the services they have received. Garber et al. [32] found in general, veterans reported a high level of satisfaction with the wheelchair they received, however, 67% reported they had received no written information about their chair, 53% reported receiving no verbal instruction about the use/maintenance of the chair, and 45% did not know who to contact if they had problems with the chair. Four veteran participants were waiting for equipment that had been ordered but never delivered and 2 participants received equipment they were unable to use. This factor reiterates the need for clinician training and follow-up. Veterans are an important source of information on the quality and durability of chairs that have as yet only been tested in the laboratory.

3.7 CONCLUSION

During FY00 and FY01, the Veterans Health Administration (VHA) provided over 131,000 wheelchairs and scooters, at a cost of \$109,010,198. Of this \$109 million, \$7,747,405 exceeded an established threshold, and was determined by this study to be excessive cost. Variation in median and potential excessive cost was found both by VISN and by vendor. At least part of this variation is attributed to lack of standardization of prosthetic purchase procedures and data entry within the VHA. Another consideration is

the possibility of fraud and abuse, which merits further investigation, but was beyond the scope of this study.

3.8 ACKNOWLEDGEMENTS

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4 CHAPTER FOUR

WHEELCHAIRS AND QUALITY OF LIFE

Relationship Between Type of Wheelchair and Health Related Quality of Life

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4.1 ABSTRACT

The purpose of this study was to investigate the relationship between the adjustability, thus capacity to customize, manual and power wheelchairs and Health Related Quality of Life (HRQoL), as measured by the SF-36V. Using a cross-sectional, retrospective study design, three years of data from three Veterans Health Administration (VHA) databases, the National Prosthetic Patient Database (NPPD), the SF-36V data of the Veteran Health Study (VHS), and the National Patient Care Database (NPCD) were merged to create a dataset 61,428 veterans who received a wheelchair during the 1999, 2000, 2001 fiscal years and completed the SF-36V in 1999. ANCOVA and ANOVA were used to analyze the first hypothesis stating veterans who are provided with more adjustable thus customizable wheelchairs will have significantly more ability to participate in society. Logistic regression was used to analyze the second hypothesis stating veterans with better health status will be prescribed more adjustable thus customizable wheelchairs. Three regression models were tested. Model I: veterans who received adjustable, ultralight manual wheelchairs had significantly lower physical function ($p < .0001$) and significantly higher mental function scores ($p = 0.019$) than veterans who received nonadjustable, standard manual wheelchairs, when adjusting for diagnosis and number of comorbidities. Model II: veterans who received adjustable, ultralight manual wheelchairs had significantly lower physical function ($p < .0001$) and significantly higher general health scores ($p = 0.015$) than veterans who received nonadjustable, standard manual chairs, when adjusting for clinical and demographic factors. Model III: veterans who received adjustable, ultralight manual wheelchairs had significantly higher mental component summary scores ($p = 0.001$) than veterans who

received nonadjustable, standard manual chairs when controlling for clinical and demographic factors.

4.2 INTRODUCTION

There is “a point at which the body and wheelchair seamlessly merge” [1], a point where the wheelchair maximizes the user’s potential - wheelchair and user become one. This harmonious blend is a balance achieved between wheelchair quality and design and user needs [2]. Key attributes of a quality manual wheelchair are reduced weight and freedom to select critical physical dimensions. Combined, these factors provide the consumer who uses manual wheelchairs with improved comfort, ease of transfers, and propulsion efficiency. Key attributes of a quality power wheelchair are programmable electronic controls, freedom to select critical physical dimensions, and flexibility to navigate indoor and outdoor terrain. Ideally, in power chairs, these factors translate into reduced attendant dependence, decreased probability of collisions, lower risk of device breakdown, better environmental access, and faster overall transit speeds. In essence, a more adjustable, customizable wheelchair facilitates more efficient mobility.

Compelling evidence exists that suggests mobility, access to the community, and social integration, enhance health related quality of life (HRQoL) [3-6]. In fact, social participation is a more important predictor of HRQoL than physical functioning or extent of injury. A poorly designed wheelchair can limit the potential of a user for community access [7] thus increasing disability.

A poorly designed manual wheelchair can contribute to secondary injuries, such as carpal tunnel syndrome and injury to the shoulder resulting from repeated, forceful movements required by the upper extremities during wheelchair propulsion [8-13]. Heavier manual wheelchairs with fewer options for adjustment are more physically demanding of the user and caregiver. The standard, steel, folding X-frame frame, sling

upholstered wheelchair design is inexpensive but provides no options for adjustment. In contrast, the ultralight wheelchair has options to select wheel-axle position, seat-back height angle, and camber (position the user in a more appropriate position in relation to gravity). Adjustable wheelchairs reduce stress and injury to the upper extremities acquired during manual wheelchair propulsion [14-17], provide better postural alignment (less head-flexion, less shoulder protraction, and more neutral pelvic tilt) resulting in greater active humeral flexion, and improved vertical reach [18], and improved functional mobility skills [19].

A poorly designed power chair can limit access of the user to the environment if the wheelchair design and features are not matched to the needs of the user (i.e. indoor versus outdoor use). Many individuals are not able to drive a standard power chair [20] due to fine and visual motor, postural, and coordination issues. Adjustable and customizable power wheelchairs offer options to maximize function for users who cannot propel a manual wheelchair. Front-wheel drive power chairs can be driven close to objects, an important consideration for individuals with visual impairment, and have better obstacle climbing abilities, i.e. climbing a curb. Rear-wheel drive power wheelchairs tend to be more stable outdoors and at faster speeds. Options available for adjustable power wheelchairs include power tilt and reclining seat, which reduces edema, shear forces, and pressure on tissues thus, diminishing the risk for the formation of pressure ulcers [21-23]. Power features such as seat elevation allow users to hold eye-level discussions with colleagues and reach items on upper shelves [24]. Programmable electronic controls can be individualized to compensate for abnormal muscle tone including tremor, sensory motor processing speed, and cognitive impairment [25].

“Smart” wheelchairs are being developed that utilize computer systems and sensors based on robotic technology to reduce both the cognitive and physical requirements of operating a power wheelchair [26-29]. Adjustable and customizable power wheelchairs can improve posture, physical and social function, and access to multiple environments, while decreasing the sensory, motor, and cognitive demands placed on the user.

The purpose of this study was to investigate the relationship between adjustable thus customizable versus nonadjustable manual and power wheelchairs and HRQoL. Acknowledging the debate over quality of life, health status, and life satisfaction terminology [6, 30-34], in this study, HRQoL encompasses the construct of self-reported health status (HS); the two terms are used interchangeably [35]. The SF-36V (Short Form 36 Item Health Survey for Veterans) [36] adapted from the Medical Outcomes Study (MOS) SF-36 [37] was used to measure HRQoL or HS. The SF-36V measures eight health concepts: physical functioning, role limitation due to physical health problems, body pain, general health, vitality, social functioning, role limitations due to emotional problems, and mental health, all universally relevant to HS [38, 39]. The physical component summary score and the mental component summary score are composite measures of the eight scales and orthogonal to each other [37, 40, 41].

The first hypothesis postulated controlling for diagnosis, number of comorbidities, and demographic factors, veterans who are provided with more adjustable thus customizable manual and power wheelchairs will report significantly more ability to participate in society. The second hypothesis was based on the assumption that as the HRQoL of the wheelchair user declines, more demand is placed on the technology to maintain user function and participation [42]. The second hypothesis postulated which,

controlling for diagnosis, number of comorbidities, and demographic factors, veterans with lower HS would be provided with more adjustable and customizable manual and power wheelchairs.

4.3 METHODS

4.3.1 Design and Participants

This study was approved as exempt by the VA Pittsburgh Healthcare System Institutional Review Board (IRB). Using a cross-sectional, retrospective design, three years of data from three Veterans Health Administration (VHA) databases, the National Prosthetic Patient Database (NPPD), the SF-36V/Veteran Health Study (VHS), and the National Patient Care Database (NPCD) were merged to create a dataset (N=61,428) of veterans who received a wheelchair during the 1999, 2000, 2001 fiscal years (FY) and completed the SF-36V.

4.3.2 Databases

NPPD: The National Prosthetics Patient Database, comprised of orthotic, prosthetic and sensory devices, was developed by the VHA Prosthetic and Sensory Aids Service (PSAS) to track devices provided to veterans and to provide clinicians with information regarding prosthetic prescription practices [43]. The NPPD was made available to researchers in 1999. The NPPD contains 25 variable fields providing information such as device description and code, geographic location of prescription, type of service (initial issue, replacement, spare, or repair), date (create date, delivery date, processing days), cost, vendor, and service category (defined in Methods/Operational Definitions). Wheelchairs, one of 14 categories of prosthetics, were

the focus of this study. Variables from the NPPD used in this study were device code, delivery date, type of service, and service category.

SF-36V/VHS: The Veteran’s Health Study, launched in 1992, was a six-year prospective, observational study of health outcomes in patients receiving outpatient care from the VHA. One of the cornerstones of the VHS was the development of the Veterans SF-36 also referred to as the V/SF-36 or SF-36V, adapted from the MOS SF-36 (Kazis, 2000; Kazis et al., 1999). In 1999, 1.4 million SF-36V questionnaires were administered nationally on a cross-sectional basis, representing 40% (3.4 million) of the VA enrollee population). Data collection took place between July 1999 and January 2000 with a response rate of 63.14%. Variables from the SF-36V used in this study were the eight scales and two component summary scores of the SF-36V. Variables from the VHS were the 30 comorbidity medical categories, sex, race, and priority group. “Comorbidities” are further described in “Methods/ Operational Definitions”.

NPCD: The National Patient Care Database [43, 44], housed at Austin Automation Center (AAC) of the VHA, contains the national datasets for each outpatient and inpatient episode of care provided by the VHA. The variables from the NPCD used in this study were primary and secondary diagnoses and date of birth.

4.3.3 Operational Definitions

Adjustability of Wheelchair: Adjustability of wheelchair was determined using the Health Care Common Procedure Coding System (HCPCS) codes, developed by the Center for Medicare and Medicaid (CMS) for reimbursement purposes. The ultralight manual wheelchair (HCPCS code = K0005) and the custom power wheelchair (HCPCS code = K0013, K0014) were considered “more adjustable and customizable”. The

standard depot manual wheelchair (HCPCS code = K0001, K0002, K0003 and associated E-codes: E1050, E1060, E1070, E1083, E1084, E1085, E1086, E1100, E1110, E1130, E1140, E1150, E1160, E1170, E1171, E1172, E1180, E1190, E1195, E1200, E1240, E1250, E1260, E1270, E1280, E1285, E1290, E1295, E1296, E1297, E1298) and the standard power wheelchair (HCPCS code = K0010 and associated E-codes: E1210, E1211, E1212, E1213, E1220) were considered “nonadjustable”. The remaining wheelchair HCPCS codes included in the NPPD were not included in this study because they were considered medium grade or mid-quality wheelchairs, not easily distinguishable as “adjustable” or “nonadjustable”.

Participation in Society: Participation in society, the dependent variable (DV) in Hypothesis 1, was measured using the Role-Physical (RP), Role-Emotional (RE), and Social Functioning (SF) scales of the SF-36V [37, 40, 41]. With the exception of the RP and RE scales, SF-36V raw scores undergo a linear transformation resulting in a range from 0-100 [36]. RP and RE scores use an algorithm developed and validated by Kazis [35, 45], in which the scores are converted based on the likelihood of a “yes” response, for the purpose of being able to compare these scores to results of studies that used the MOS version of the SF-36. Thus, in this study, RP scores ranged from -6.75 to 111.45, and RE scores ranged from -16.95 to 115.30. The physical component score (PCS) and mental component score (MCS) scores undergo a t-score transformation with a norm of 50 in a U.S. reference population, with no floor or ceiling. For all SF-36V scale and component summary scores, a higher score indicates better health, or health status [36].

Health Status: The construct of HS, the independent variable (IV) in hypothesis 2, was measured using all eight scales and the two summary scores of the SF-36-V: PF,

Role-Physical (RP), Bodily Pain (BP), General Health (GH), Vitality (VT), SF, RE, Mental Health (MH), PCS, and MCS. Three models were analyzed, each defining HS somewhat differently in that each of the three models used a different combination of SF-36V scale and summary scores. Model I used the PF and MH scores to define HS, Model II used all eight of the SF-36V scores to define HS, and Model III used only the PCS and MCS scores.

Priority Group: The VHA has delineated seven priority groups. The first three are comprised of veterans with service-connected disabilities. Group 1 includes veterans with disabilities rated $\geq 50\%$, Group 2 includes veterans with disabilities rated 30% or 40%, and Group 3 includes veterans who have service-connected disabilities rated 10% or 20%, were discharged from active duty for disabilities incurred or aggravated in the line of duty, received the Purple Heart, or are former POWs. Veterans in Group 4 receive aid and attendance or housebound benefits, or have been determined by the VHA to be catastrophically disabled, i.e. spinal cord injury (SCI). Veterans in Group 5 are low income, nonservice-connected veterans. Group 6 is a special category of veterans, who have been exposed to Agent Orange or radiation for example, who are not required to make co-payments for their care. Group 7 is comprised of high income, nonservice-connected and 0% service-connected veterans who are required to make co-payments [46-48].

Service Category: Service categories designate whether the device was provided for a service-connected or nonservice-connected diagnosis, and prescribed during an inpatient or outpatient episode. Service categories include: service-related and inpatient

(SC/IP), service-related and outpatient (SC/OP), nonservice-related and inpatient (NSC/IP), and nonservice-related and outpatient (NSC/OP).

Demographic Variables: The demographic variables of age, gender, race/ethnicity, service category, and priority group were selected according to availability of variables and clinical relevancy. Age was defined as the age of the veteran when the wheelchair was prescribed. Race/ethnicity were designated as Caucasian (76% of sample), African American (12%), Hispanic (6%), American Indian (5%), Hawaiian (<1%), or Asian (<1%). Gender was either male (96%) or female (4%).

Clinical Variables: The clinical variables were diagnosis and number of comorbidities. Diagnostic categories were formed by extracting International Classification of Disease - Revision 9 (ICD-9) codes [49] for the primary diagnoses of all FY99, FY00, and FY01 encounters for all participants from the inpatient and outpatient NPCD datasets. A SAS® program was used to assign each participant one primary diagnosis most related to wheelchair-use. The most frequently occurring wheelchair-use related ICD-9 codes, ranked in order of their likelihood of being the diagnosis most related to the wheelchair prescription (based on the authors' clinical experience) were: amyotrophic lateral sclerosis (ALS), multiple sclerosis (MS), spinal cord injury-tetraplegia (SCIT), spinal cord injury-paraplegia (SCIP), stroke, traumatic brain injury (TBI), Parkinson's disease (PD), amputee, chronic obstructive pulmonary disorder / chronic heart failure (COPD/CHF), and arthritis. An "other" category was established for primary diagnoses other than those listed.

Number of comorbidities was a continuous variable developed by sorting the secondary diagnoses from the inpatient and outpatient NPCD data into 30 medical

categories (anemia, chronic heart failure, diabetes, stroke, etc.). This method of calculating comorbidities was developed by Kazis and colleagues [35, 36] during the VHS. If a veteran had a comorbidity that was also their primary diagnosis, the comorbidity count was decreased accordingly. For example, if the primary diagnosis of a veteran was stroke, which was also one of the 30 possible medical comorbidity categories, the comorbidity count of the veteran was reduced by one.

4.3.4 Data Preparation

Following IRB approval, the NPPD was obtained from the VA Information Resource Center (VIREC) [43] at Hines, IL. Demographic data from the NPCD were downloaded from the AAC [43]. Unique scrambled patient identifiers from the NPPD were submitted to the AAC. Within the AAC system, the scrambled patient identifiers were unscrambled to secure NPCD data for the particular veteran identifiers submitted. The patient identifiers were then re-scrambled and the NPCD data returned. Thus at no time did the investigators have access to unscrambled patient identifiers.

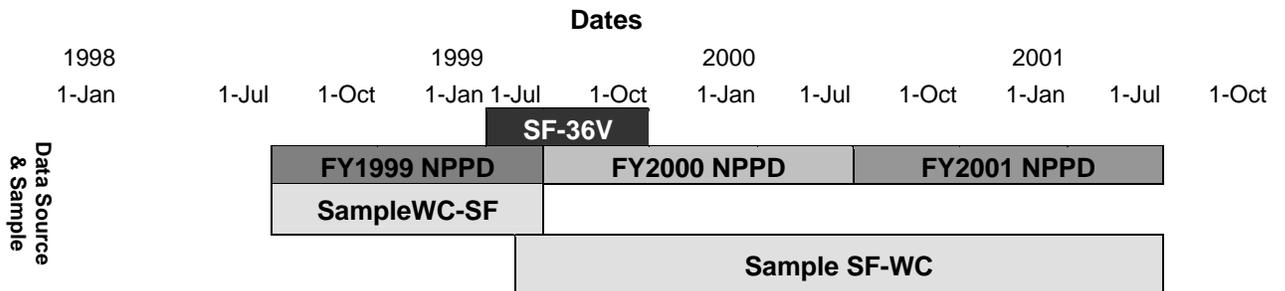
After entering into a data use agreement with Office of Quality and Performance (OQP), scrambled patient identifiers of veterans who had received a wheelchair during FY99, FY00, or FY01 were provided to the Center for Health Quality, Outcomes, and Economic Research, at the Bedford VAMC, where the SF-36V/VHS data are housed. The SF-36V/VHS data for veterans receiving wheelchairs were received on a CD, and again, at no time did the investigators have access to unscrambled patient identifiers.

Data Cleaning and Data Subset Preparation: General data cleaning was performed based upon decision rules developed during a collaborative validity study of the NPPD [50] and previous NPPD studies by this investigative team [51, 52]. Additional

data cleaning and preparation specific to this study were performed as follows: wheelchair records of veterans who received their wheelchairs the same day they completed the SF-36V, wheelchair records where the delivery date preceded the order date were excluded, and only wheelchairs with HCPCS codes listed in Operational Definitions/Adjustability of Wheelchair were included. The 61,428 records of wheelchairs provided to veterans during the Federal FY99, FY00, or FY01 who completed the SF-36V during the 1999 calendar year were reduced to 42,919 records with the HCPCS codes designated above. Separate analyses were run on manual and power wheelchairs.

Because participants received wheelchairs across all three years of the study, but the SF-36V administrations took place only between July of 1999 and January of 2000, participants could have received their wheelchair before or after completing the SF-36V (Table 29). Thus, two sub-samples were formed: the determining criterion was whether veterans received their wheelchairs before or after completing the SF-36V. Wheelchair records of participants who received their wheelchairs then completed the SF-36V were assigned to “SampleWC-SF” (n=3,427). Wheelchair records of participants who completed the SF-36V then received their wheelchairs were assigned to SampleSF-WC (n=33,781).

Table 28 Comparison of the administration dates of the SF-36V and the wheelchair delivery data



4.4 ANALYSES

ANCOVA, ANOVA and the data subset “SampleWC-SF” were used to address hypothesis 1, stating veterans provided with more adjustable wheelchairs (IV) would subsequently demonstrate better social participation (DV). Social participation was defined by the role limitations due to physical or emotional problems, and social functioning SF-36V scores. The data subset “SampleWC-SF” was limited to veterans receiving their first wheelchair use (type service variable = “initial issue”) to control for the effect of previous, unknown wheelchairs on social participation, and veterans who had had their wheelchairs at least 90 days. Ninety days was deemed adequate time to adjust the wheelchair prior to measurement of social participation. The resulting “SampleWC-SF” = 3,427 records.

The dataset “SampleWC-SF” was divided into two groups for analysis: Group 1 consisted of veterans who received manual chairs (n=3,178) and Group 2 consisted of veterans who received power wheelchairs (n=249) (Figure 9). Therefore, manual and power chair users were analyzed separately as a means of controlling for severity of body impairment, as power chair users typically have less gross and fine motor control than manual chair users.

Within Group1 (manual chair users, n = 3,178) were participants who received adjustable manual chairs (1MA, n=77) and participants who received nonadjustable manual chairs (1MN, n=3,101). Within Group 2 (power chair users, n = 249) were participants who received adjustable power chairs (2PA, n=73) and participants who received nonadjustable power chairs (2PN, n=176).

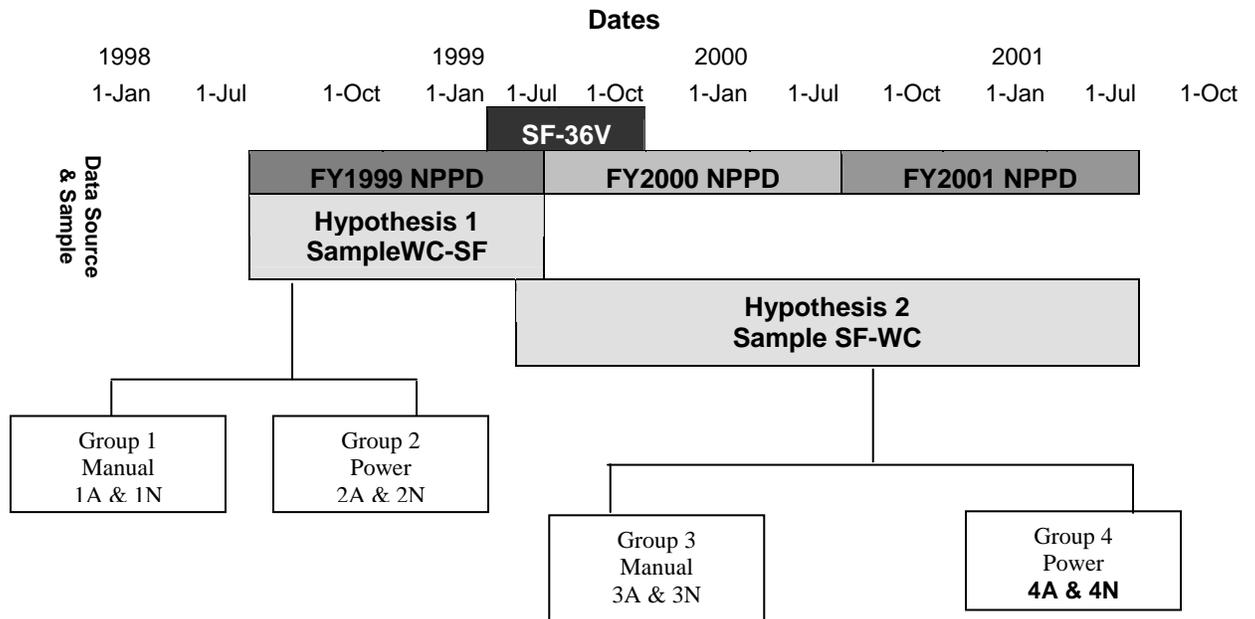


Figure 9 Diagram of sub-samples and groups per hypotheses 1 and 2

Univariate (t-tests and chi-square) analyses were performed to compare manual chair users, 1MA and 1MN, and to compare power chair users, 2PA and 2PN. ANCOVA was then performed to test for significant differences in RE (the only significant main effect found) among manual chair users who received adjustable versus nonadjustable chairs, controlling for diagnosis and number of comorbidities. For power wheelchair users, ANOVA was performed to test for significant differences in RE and SF (significant main effects) between veterans who received adjustable versus nonadjustable chairs. Neither of the confounding variables, diagnosis or number of comorbidities, were significant for power chair users.

Logistic regression and the data subset SampleSF-WC were used to address hypothesis 2, stating veterans with lower HS (IV) would subsequently be provided with adjustable and customizable manual and power wheelchairs (DV). All wheelchairs received after completing the SF-36V were included in the analysis, whether the

wheelchair was an “initial issue,” “replacement,” or “spare.” The number of records included in the analysis of hypothesis 2 was 33,871. Since the veteran could have received their wheelchair in FY99, FY00, or FY01, year was included as a control variable.

The dataset “SampleSF-WC” was also divided into two groups: Group 3 consisted of participants who received manual wheelchairs (n=30,585) and Group 4 consisted of participants who received power wheelchairs (n=3,196) (Figure 9). Within Group 3 were participants who received adjustable manual chairs (3MA, n=1,438) and (3MN, n=29,147). Within Group 4 were participants who received adjustable power chairs (4PA, n=1,194) and nonadjustable power chairs (4PN, n=2,002).

Univariate (t-tests and chi-square) analyses were performed to compare manual chair users, 3MA and 3MN, and power chair users, 4MA and 4PN. Logistic regression was then performed for each of the three models, testing for significant differences in HS for veterans who received adjustable versus nonadjustable manual wheelchairs: *Model I* used the PF and MH SF-36V scores to predict HS, adjusting for diagnoses and number of comorbidities. *Model II* used all eight of the SF-36V scores to predict HS. *Model IIIA* adjusted for diagnoses, number of comorbidities, and demographic factors, and *Model IIIB* was unadjusted. *Model III* used the PCS and MCS SF-36V scores to predict HS. *Model IIIA* adjusted for diagnoses, number of comorbidities, and demographic factors, and *Model IIIB* was unadjusted.

For hypotheses 1 and 2, IV and confounding variables (CV) significant at 0.10 in the univariate analyses were entered into the model (ANCOVA, ANOVA or logistic regression). Hypotheses were tested at the alpha $p \leq 0.5$ level of significance. For

hypothesis 1, both of the significant main effects, RE and SF, met the normalcy assumption. For hypothesis 2, correlations between the IV (SF-36V scales) were less than $r = 0.60$. SAS® version 8.2 [53] software was used for all analyses.

4.5 RESULTS

The results of the t-test and chi-square univariate analyses for hypothesis 1 (Table 30) were as follows:

Manual wheelchair users: For the main effects, veterans who received adjustable manual wheelchairs had higher RE scores (less role limitation due to emotional problems). For the confounding variables, both diagnosis and number of comorbidities were significant. All diagnoses received a higher percentage of nonadjustable wheelchairs. The diagnoses receiving the highest percentage of adjustable manual chairs were SCIT (22%), SCIP (15%), and MS (13%). Veterans who received adjustable chairs had fewer comorbidities.

Power wheelchair users: For the main effects, veterans who received adjustable power wheelchairs had higher RE and SF scores. Neither of the confounding variables, diagnosis and number of comorbidities, were significant. The diagnoses receiving the highest percentage of adjustable power chairs were PD (57%), SCI-tetraplegia (42%), and MS (36%). In fact for veterans with a primary diagnosis of PD, a higher percentage of custom power chairs were provided than standard power chairs.

Table 29 Univariate results for hypothesis 1

		SampleWC-SF Independent Variable: Adjustable Vs. Nonadjustable Wheelchair									
		Group 1MA		Group 1MU			Group 2PA		Group 2PN		
		Manual Adjust		Manual Non-Adjust			Power Adjust		Power Non-Adjust		
		Ultralight		Depot			Custom Power		Standard Power		
		n	mean(sd)	n	mean(sd)	p	n	mean(sd)	n	mean(sd)	p
D.V: SF-36V Social Participation Scores and Confounding Variables	Role Physical	66	9.6 (32.4)	2438	4.1 (25.2)	0.17	69	5.1 (27.7)	147	(-) 0.7 (18.8)	0.118
	Role Emotional	65	40.8 (50.8)	2374	23.3 (42.7)	0.008*	68	29.0 (44.2)	142	14.5 (37.0)	0.013*
	Social Function	68	34.0 (32.1)	2468	30.0 (27.7)	0.239	68	34.7 (27.1)	147	27.5 (24.6)	0.052*
	# Comorbidity	72	5.7 (3.2)	3020	6.5 (3.7)	0.047*	66	5.7 (3.4)	170	6.1 (3.6)	0.299
	Diagnoses	77	frequency	3065	frequency	p	72	frequency	172	frequency	p
	ALS	1	3%	30	97%		0	0%	4	100%	
	MS	9	13%	59	87%		12	36%	21	64%	
	SCI-tetra	10	22%	35	78%		11	42%	15	58%	
	SCI-para	8	15%	45	85%		2	18%	9	82%	
	Stroke	16	3%	569	97%		9	33%	18	67%	
	PD	3	3%	115	97%		4	57%	3	43%	
	Amputee	4	3%	136	97%		4	31%	9	69%	
	COPD/CHF	10	1%	774	99%		13	24%	42	76%	
	Arthritis	4	1%	372	99%		8	25%	24	75%	
	*significant at 0.10										

ANCOVA and ANOVA results for hypothesis 1 partially supported the alternative hypothesis: veterans who received adjustable wheelchairs demonstrated better social participation on one out of three measures for manual wheelchair users, and two out of three measures for power wheelchair users.

Manual Wheelchairs: The ANCOVA results, controlling for diagnosis and number of comorbidities, indicated veterans who were prescribed adjustable, ultralight wheelchairs demonstrated significantly less ($p=0.004$) role limitation due to emotional problems than veterans who were prescribed standard, nonadjustable wheelchairs.

Power Wheelchairs: ANOVA results indicated veterans who were prescribed adjustable, custom power wheelchairs also demonstrated significantly less ($p=0.013$) role

limitation due to emotional problems than veterans who were prescribed standard, nonadjustable wheelchairs. In addition, veterans prescribed adjustable, custom power wheelchairs demonstrated better ($p=0.052$) social functioning than veterans who were prescribed standard, nonadjustable wheelchairs, though technically not statistically significant at $p \leq 0.05$.

The results of the t-test and chi-square univariate analyses for hypothesis 2 (Table 31), were as follows:

Manual Wheelchairs: All proposed SF-36V scales had significant relationships with whether an adjustable versus nonadjustable manual wheelchair was provided, thus all were entered into at least one of the logistic regression models.

A higher percentage of adjustable manual wheelchairs were provided for veterans with lower (poorer function) physical functioning ($p < .0001$) and physical component summary ($p=0.017$) scores. In contrast, veterans who received adjustable manual wheelchairs had higher scores (better function) in all other scales: role limitation due to physical ($p=0.017$) and emotional ($p < .0001$) problems, body pain ($p = 0.021$), general health ($p < .0001$), mental health ($p = < .0001$), social functioning ($p = 0.037$), vitality ($p = < .0001$), and mental component ($p = < .0001$).

Five percent of female veterans received adjustable manual wheelchairs whereas only 4% of female veterans received adjustable power wheelchairs. The diagnoses receiving the highest percentage of adjustable manual chairs were SCI-paraplegia (34%), SCI-tetraplegia (37%), and MS (16%). The highest percentage of adjustable manual chairs were provided to priority groups 1 and 4 (wheelchairs provided for veterans with disability rated more than 50% or catastrophic) and for service-connected diagnoses with

the device prescribed during an outpatient episode. Hispanics received a higher percentage of adjustable manual chairs than any of the non-Hispanic ethnic categories.

Power Wheelchairs: None of the SF-36V scores had a significant relationship with whether an adjustable versus nonadjustable power wheelchair was prescribed, thus no logistic regression model was created for power wheelchairs.

The diagnoses receiving the highest percentage of adjustable power chairs were ALS (51%), SCI-tetraplegia (47%), and SCI-paraplegia (44%). The highest percentage of adjustable power wheelchairs were provided to priority groups 1, 4, and 7 (wheelchairs provided for veterans with disability rated more than 50% or catastrophic and veterans required to make a co-pay) and for service-connected diagnoses with the device prescribed during an inpatient episode. Hispanics received a higher percentage of adjustable power chairs than any of the non-Hispanic ethnic categories.

Table 30 Univariate results for hypothesis 2

		SampleSF -WC Dependent Variable: Adjustable Vs. Nonadjustable Wheelchair										
		Group 3MA		Group 3MN			Group 4PA		Group 4PN			
		Manual Adjust		Manual Non-Adjust			Power Adjust		Power Non-Adjust			
		Ultralight		Depot			Custom Power		Standard Power			
		n	mean(sd)	n	mean(sd)	p	n	mean(sd)	n	mean(sd)	p	
IV : SF-36V Health status Scores and Confounding Variables	Physical Functioning	753	19.2 (24.7)	16785	25.4 (26.1)	<.0001*	675	13.8 (25.2)	1062	12.7 (21.8)	0.365	
	Role Limitation Physical	744	11.8 (30.9)	16466	9.1 (28.3)	0.017*	663	4.3 (27.0)	1046	4.1 (25.0)	0.833	
	Body Pain	762	35.4 (25.6)	16783	33.2 (25.1)	0.021*	678	29.4 (25.8)	1083	28.8 (24.9)	0.492	
	General Health	756	36.0 (24.6)	16558	30.6 (21.0)	<.0001*	672	28.1 (22.4)	1073	28.9 (20.9)	0.429	
	Mental Health	760	59.6 (25.2)	16745	55.5 (24.4)	<.0001*	682	55.1 (26.0)	1078	54.6 (24.9)	0.667	
	Role Limitation Emotional	730	36.5 (47.8)	16220	28.2 (44.5)	<.0001*	652	29.2 (47.0)	1031	28.3 (44.4)	0.689	
	Social Functioning	760	41.0 (31.2)	16794	38.6 (29.5)	0.037*	682	32.3 (29.3)	1086	34.1 (28.6)	0.195	
	Vitality	760	35.7 (24.2)	16797	28.9 (21.9)	<.0001*	682	26.4 (23.0)	1079	27.9 (21.6)	0.167	
	Physical Component	702	25.0 (8.4)	15627	25.8 (8.8)	0.017*	629	22.4 (8.0)	983	22.3 (7.1)	0.762	
	Mental Component	702	43.2 (14.4)	15627	39.4 (13.1)	<.0001*	629	39.9 (14.7)	983	40.6 (13.8)	0.491	
	# Cormorbidity	1284	4.6 (3.1)	27741	5.7 (3.2)	<.0001*	1103	5.5 (3.6)	1829	5.6 (3.4)	0.328	
	Age	1409	59.5 (15.0)	28664	68.7 (12.6)	<.0001*	1156	62.0 (13.5)	1953	63.5 (13.2)	0.003*	
		n	frequency	n	frequency	p	n	frequency	n	frequency	p	
		Diagnoses				<.0001*					<.0001*	
		ALS	10	5%	181	95%		32	51%	31	49%	
		MS	106	16%	556	84%		153	40%	228	60%	
		SCI-tetra	302	37%	515	63%		305	47%	342	53%	
		SCI-para	275	34%	532	66%		95	44%	120	56%	
		Stroke	151	3%	4684	97%		135	35%	250	65%	
		PD	32	4%	871	96%		21	44%	27	56%	
	Amputee	79	6%	1301	94%		42	28%	108	72%		
	COPD/CHF	102	1%	6761	99%		172	34%	335	66%		

		SampleSF -WC Dependent Variable: Adjustable Vs. Nonadjustable Wheelchair									
		Group 3MA		Group 3MN			Group 4PA		Group 4PN		
		Manual Adjust		Manual Non-Adjust			Power Adjust		Power Non-Adjust		
		Ultralight		Depot			Custom Power		Standard Power		
		n	mean(sd)	n	mean(sd)	p	n	mean(sd)	n	mean(sd)	p
Arthritis	84	2%	3462	98%		69	29%	171	71%		
Priority Group					<.0001*					0.020*	
1	578	8%	67	92%		503	39%	796	61%		
2	74	3%	2132	97%		45	29%	111	71%		
3	99	3%	2899	97%		60	29%	145	71%		
4	343	9%	3513	91%		320	40%	486	60%		
5	221	2%	10969	98%		187	35%	346	65%		
6	6	4%	133	96%		2	29%	5	71%		
7	23	3%	689	97%		18	40%	27	60%		
Service Category					<.0001*					<.0001*	
NSC/IP	135	3%	4458	97%		110	51%	105	49%		
NSC/OP	762	4%	19304	96%		661	36%	1189	64%		
SC/IP	34	3%	823	96%		38	61%	24	39%		
SC/OP	507	35%	4796	90%		386	36%	687	34%		
Gender					0.003*					0.300	
Male	1364	95%	28220	97%		1132	96%	1898	95%		
Female	96	5%	982	3%		48	4%	97	5%		
Race/ethnicity					<.0001*					0.310	
Caucasian	530	4%	12253	96%		532	38%	865	62%		
African American	107	5%	2191	95%		76	40%	112	60%		
Hispanic	96	7%	1245	93%		27	51%	26	49%		
Native American	22	3%	805	97%		34	3%	63	97%		
Hawaiian	1	1%	100	99%		3	1%	10	99%		
Asian	4	4%	122	97%		3	3%	7	97%		

*significant at 0.10

Logistic regression results for hypothesis 2 are presented by model. Of the three models analyzed, the adjusted models (Models I, IIA, and IIIA) had a better fit [54] than the unadjusted models. Of the three adjusted models, Model IIA ($c=0.81$) and Model IIIA ($c=0.80$) had a better fit than Model I ($c=0.77$).

Model I defined HS using PF and MH SF-36V scores, adjusting for diagnoses and number of comorbidities (Table 32). Veterans who received adjustable, ultralight manual wheelchairs had significantly lower physical function ($p<.0001$) and significantly higher mental function scores ($p=0.019$) than veterans who received nonadjustable, depot chairs when controlling for diagnosis and number of comorbidities. For every 10-point decrease in PF score, a veteran was 1.08 times more likely to receive an ultralight chair. For every 10-point increase in MH score, a veteran was 1.04 times more likely to receive an ultralight chair.

Model II defined HS using all eight of the SF-36V scores. Model IIA adjusted for diagnoses, number of comorbidities, and demographic factors. Model IIB was unadjusted (Table 33). When all eight of the SF-36V scores were considered simultaneously, only physical function ($p<.0001$), role limitation due emotional problems ($p=0.012$), general health ($p<.0001$), and vitality ($p<.0001$) were significant. When model II was adjusted, only physical function ($p<.0001$) and general health ($p=0.015$) remained significant predictors of type of wheelchair received.

Veterans who received adjustable, ultralight manual wheelchairs had significantly lower physical function ($p<.0001$) and significantly higher general health scores ($p=0.015$) than veterans who received nonadjustable, depot chairs when controlling for clinical and demographic factors. For every 10-point decrease in PF score, a veteran was

1.10 times more likely to receive an ultralight chair. For every 10-point increase in GH score, a veteran was 1.06 times more likely to receive an ultralight chair.

Model III defined HS using the PCS and MCS scores of the SF-36V. Model IIIA adjusted for diagnoses, number of comorbidities, and demographic factors. Model IIIB was unadjusted (Table 34). In model IIIB, both PCS ($p=.013$) and MCS ($p<.0001$) were significant. However, when adjusted for clinical and demographic factors, only MCS remained significant ($p=.001$).

Veterans who received adjustable, ultralight manual wheelchairs had significantly higher mental component summary scores ($p=0.001$) than veterans who received nonadjustable, depot chairs when controlling for clinical and demographic factors. For every 10-point increase in MCS score, a veteran was 1.10 times more likely to receive an ultralight chair.

Table 31 Model I logistic regression results

DV: Adjustability of Manual Wheelchair										
Criterion = Group 2 - unadjustable manual depot wheelchair										
		Coefficient	Std Error	Wald CI	p value	Adj OR	OR	95% CI	c	R-sq
SF-36V Scores	IV:									
	Physical Function-a	0.008	0.002	17.27	<.0001*	1.080	1.008	1.004-1.011	0.772-a	0.056-a
Mental Health-a	-0.004	0.002	5.42	0.020*	0.959	0.996	0.992-0.999			

* significant at p=0.05 and CI does not include 1
a = adjusted for diagnosis, number of comorbidities, year
Adj OR = OR for every 10 point change in score

Table 32 Model II logistic regression results

DV: Adjustability of Manual Wheelchair										
Criterion = Group 2 - unadjustable manual depot wheelchair										
	Coefficient	Std Error	Wald CI	p value	Adj OR	OR	95% CI	c	R-sq	
IV:Sf-36V Scores	Physical Function	0.023	0.002	107.80	<.0001*	1.252	1.023	1.018-1.027	0.650 0.805-a	0.014 0.066-a
	Physical Function-a	0.009	0.002	16.81	<.0001*	1.096	1.009	1.005-1.014		
	Role Physical	-0.004	0.002	4.72	0.030	0.965	0.996	0.993-1.00		
	Role Physical-a	-0.0007	0.002	0.11	0.743	0.993	0.999	0.995-1.003		
	Body Pain	0.002	0.002	0.99	0.321	1.019	1.002	0.998-1.006		
	Body Pain-a	0.003	0.002	1.55	0.213	1.030	1.003	0.998-1.008		
	General Health	-0.012	0.002	22.88	<.0001*	0.891	0.988	0.984-0.993		
	General Health-a	-0.007	0.003	5.89	0.015*	0.935	0.993	0.988-0.999		
	Mental Health	0.002	0.002	0.64	0.423	1.019	1.002	0.997-1.006		
	Mental Health-a	-0.001	0.003	0.24	0.622	0.987	0.999	0.994-1.004		
	Role Emotional	-0.003	0.001	6.120	0.013*	0.973	0.997	.0995-0.999		
	Role Emotional-a	-0.0006	0.001	0.21	0.651	0.994	0.999	0.997-1.002		
	Social Function	0.003	0.002	1.66	0.197	1.026	1.003	0.999-1.006		
	Social Function-a	0.0003	0.002	0.02	0.898	1.003	1.000	0.996-1.005		
Vitality	-0.015	0.002	39.10	<.0001*	0.863	0.985	0.981-0.990			
Vitality-a	-0.004	0.003	2.20	0.138	0.959	0.996	0.990-1.001			

* significant at p=0.05 and CI does not include 1

a = adjusted for diagnosis, number of comorbidities, priority group, service category, age, gender, race/ethnicity, year

Adj OR = OR for every 10 point change in score

Table 33 Model III logistic regression results

DV: Adjustability of Manual Wheelchair										
Criterion = Group 2 - unadjustable manual depot wheelchair										
		Coefficient	Std Error	Wald CI	p value	Adj OR	OR	95% CI	c	R-sq
IV:SF-36V Scores	PCS	0.011	0.004	6.12	0.013*	1.115	1.011	1.002-1.020	0.582 0.798- a	0.004 0.065- a
	PCS-a	0.009	0.005	2.61	0.106	1.090	1.009	0.998-1.019		
	MCS	-0.021	0.003	52.87	<.0001*	0.813	0.980	0.974-0.985		
	MCS-a	-0.010	0.003	9.96	0.001*	0.902	0.990	0.983-0.996		

* significant at p=0.05 abd CI does not include 1

a = adjusted for diagnosis, number of comorbidities, priority group, service category, age, gender, rece/ethnicity, year

Adj OR = OR for every 10 point change in score

4.6 DISCUSSION

In the U.S. general population, 40% of individuals who use wheelchairs report poor health and 96% report activity limitation [55]. The purpose of the study described herein was to establish a relationship between adjustability, thus customizability, of wheelchairs and HS or HRQoL.

The first hypothesis investigated the effect of adjustable versus nonadjustable wheelchairs on social participation. Veterans who received adjustable manual and power wheelchairs were found to have less role limitation due to emotional problems. In addition, veterans who received adjustable power wheelchairs had better social functioning. Social participation was only measured at one point in time, which was a study limitation. Thus these veterans may have had less role limitation due to emotional problems and better social functioning prior to receiving their wheelchairs. In fact, they may have received the adjustable wheelchair because they were more emotionally and socially adept, and therefore better able to self-advocate. A future longitudinal study in which outcomes data are collected at more than one time point is needed to validate these findings. This longitudinal study would allow for a comparison of pre- and post- data or for the use of receipt of wheelchair scores as a control factor.

The population of this study (veterans who received wheelchairs from the VHA), was a second limitation, as the population was comprised of a ten diagnostic groups plus an “other” diagnostic category. The effect a wheelchair may have on social participation may vary with diagnosis or circumstances under which the wheelchair was prescribed. For example, veterans may receive their wheelchairs after an acute event, such as a stroke. For these veterans, social participation scores may possibly reflect a decrease in

social participation due to the sudden, debilitating effects of a stroke and associated new wheelchair prescription for abrupt inability to ambulate. In contrast, for veterans with long term, progressive disabilities, receipt of a wheelchair may have a more positive effect on social participation. For these veterans, whose ambulation may have slowly deteriorated over the years, a device that enhanced their slowly declining mobility would have the effect of improving their social participation scores. To address this limitation, a subsequent analysis of hypothesis 1 was performed on a data set limited to veterans with MS, COPD/CHF, and arthritis. Limiting the dataset to progressive disorders, however, decreased the significance of the findings. Decreasing power by reducing the number of records included in the analysis could have been a factor for less significant findings. Limited information has been published using the SF-36 in populations who use wheelchairs. Trefler et. al [56] showed significant improvements in social functioning after wheelchair receipt, however, this work had limitations in the populations studied and the level of disability.

A prospective study has been proposed to address the variance attributed to multiple diagnoses by focusing on one diagnosis – stroke. In addition, the prospective study design will allow administration of the SF-36V pre- and post- receipt of wheelchair. Outcomes data on participant “activity” based on the World Health Organization International Classification of Function [57] model will also be collected. A second study also proposed, will be a cross-sectional, retrospective designed study, that will link NPPD data with the Functional Status and Outcomes Database (FSOD) [58] based on the Functional Independence Measure™ (FIM™) [59], Again participation will be limited to veterans with stroke. Linking the NPPD with the FSOD will provide

information on type of wheelchairs provided by functional level of participants.

The results of the analyses of hypothesis 2 suggested HS significantly predicted whether an adjustable or nonadjustable manual wheelchair was prescribed, but HS was not a predictor of whether an adjustable or nonadjustable power wheelchair was prescribed. Veterans who received adjustable, ultralight manual wheelchairs had significantly lower physical function scores, as measured by the SF-36V, and significantly higher mental function, general health, and mental component summary scores than veterans who received nonadjustable, depot chairs, after adjusting for clinical and demographic factors.

Interestingly, less variability was noted in the SF-36V scores of veterans receiving power wheelchairs than in the SF-36V scores of veterans receiving manual wheelchairs. For example, for manual chair recipients, the range of variability in mean SF-36V scores of those who received adjustable versus nonadjustable chairs was two to eight points, compared to a range of 0.1 to 1.8 points for power chair recipients (Table 3). In other words, more differences were found in HS of veterans who received adjustable manual wheelchairs versus nonadjustable manual wheelchairs. Conversely, little difference was determined in HS of veterans who received adjustable power wheelchairs versus nonadjustable power wheelchairs. The smaller variation among power users may have contributed to lack of significant findings. Less variation in characteristics of veterans who received power wheelchairs versus manual wheelchairs was found in another study by this investigative team [51]: stronger evidence was found for ethnic variation among veterans receiving manual wheelchairs from the VHA than veterans receiving power chairs from the VHA.

Further, the variability in mean HS scores of veterans receiving manual versus power chairs was not always in the same direction, suggesting manual chairs may have a different effect on HS than power chairs. For example, veterans who received ultralight manual chairs had lower mean PF and PCS scores than veterans who received depot manual chairs, indicating veterans receiving adjustable manual wheelchairs had lower physical function. In contrast, veterans receiving custom power wheelchairs had higher PF and PCS scores than veterans who received standard, nonadjustable power wheelchairs. A similar inverse trend was noted for GH, SF, VT, PCS, and MSC scores, however, the effect was reversed. Veterans receiving adjustable manual chairs had higher GH, SF, VT, PCS, and MSC scores. Veterans who received adjustable power chairs had lower GH, SF, VT, PCS, and MSC scores. Overall, veterans who received manual wheelchairs had higher HS than veterans who received power wheelchairs. More variability existed in HS among manual chair recipients than power chair recipients, but approximately ten times more manual chairs were provided by the VHA than power chairs, thus more opportunity for variability. The variability in HS between manual and power recipients was not merely a matter of degree. The HS profiles of veterans who received adjustable manual chairs differed from the profiles of veterans who received adjustable power chairs.

Other limitations of this study include lack of established reliability and validity for using the SF-36 or SF-36V with a non-ambulatory population in addition to concerns about reliability and validity of the NPPD data itself [50-52, 60]. Although the SF-36 norms are available for persons with chronic conditions that affect mobility yet remain ambulatory [6], and the SF-36 has been used extensively with individuals with SCI, MS,

ALS, PD, and stroke, who are frequently non-ambulatory [61-70], the SF-36 has not been standardized on individuals who use wheelchairs. Therefore, sensitivity of the SF-36V is to changes in HS of non-ambulatory veterans is unknown. Work towards standardization of the SF-36 for individuals with SCI, who are typically nonambulatory, has focused on the physical and mental component scores. In a study not yet published, Forchheimer (M. Forchheimer, written communication, February 17, 2003) found the factor structure of the SF-36 to be appropriate for use with SCI. In addition, the physical component score (PCS), but not the mental component score (MCS), of the SF-36 were associated with severity of neurological impairment. Several of the items on the physical functioning subscale (items 6, 7, 9-11) were found to be insensitive to the paralytic symptoms associated with SCI in a study by Tate et. al [6], who have made slight modifications to the wording of these items. For example, three items that dealt with walking were modified to use the verb “going”. Two items that dealt with stair climbing were changed to “going up several flights of stairs”. For persons with SCI, this wording allowed for the use of assistive devices without penalty. When using this modified version, the SF-36 yielded a very strong relationship between the physical functioning subscale and the motor scale of the FIM, suggesting adequate construct validity [6].

The study described herein and other NPPD studies [50-52, 60] have found inconsistencies in the coding of devices due to lack of standardization of data entry. For example, the code of the device may have designated a scooter, when in fact, after examining other fields such as vendor and cost, it became apparent that the veteran actually received a power wheelchair. In addition, inconsistencies in the coding of diagnoses were also found within the dataset. For example, within the NPCD, a veteran

may have been coded with ICD-9 code representing the diagnosis SCI-paraplegia, but also coded as having an injury at the cervical level. Therefore, considering SCI as one category, rather than interpreting data for veterans with tetraplegia separately from veterans with paraplegia, may be more reliable.

Policy Implications: The mission of the VHA is to provide equitable, standardized, and quality care to veterans. A question that comes to mind is “Is the provision of wheelchairs equitable?” Or do VHA facilities with seating and mobility clinics provide a different quality wheelchair than facilities lacking this specialized expertise? In a study of 412 individuals with SCI who use wheelchairs full-time, who received their wheelchairs from SCI centers of excellence, Hunt et. al [71], 97% of manual wheelchair participants had ultralight wheelchairs. The remaining 3% used manual wheelchairs that were not ultralights. In contrast, 3% of the manual wheelchairs provided by the VHA are adjustable, ultralight wheelchairs [51]; 13% of veterans with SCIT, and 13% of veterans with SCIP received ultralight wheelchairs during the fiscal years 1999 to 2001. In addition, in the Hunt et. al study [71], no participants received a standard wheelchair. In contrast, the study described herein found the standard wheelchair to be the most frequently prescribed power wheelchair for individuals with tetraplegia and paraplegia due to SCI. Based on the relatively few ultralight wheelchairs provided by the VHA (3%), it is not surprising that a stronger relationship between physical health status and adjustability, therefore customizability of wheelchair was not found.

4.7 CONCLUSION

Veterans who received adjustable, ultralight manual wheelchairs had significantly lower physical function scores, as measured by the SF-36V, and significantly higher mental function, general health, and mental component summary scores than veterans who received nonadjustable, depot chairs, when adjusting for clinical and demographic factors.

The evidence for an association between adjustable wheelchairs and higher mental function was stronger than the evidence for an association between adjustable wheelchairs and lower physical function. The inability of the veteran functioning at a lower mental level to self-advocate, clinician bias, and safety considerations are factors possibly effecting the provision of adjustable wheelchairs to veterans with higher mental function. The weak association between the provision of adjustable wheelchairs and lower physical function may have been affected by the relatively few adjustable wheelchairs provided to veterans by the VHA.

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5 CHAPTER FIVE

5.1 CONCLUSIONS

An underlying goal of this dissertation was to explore the as yet unexplored NPPD database, a small step towards realizing the long-range goal of documenting functional outcomes of various types of wheelchairs and scooters. Had King Philip of Spain had the selection of wheelchairs available to him in 1595 that are available now, certainly he would have wanted to know which wheelchair would best meet his needs. The king's court would have wanted documentation of the benefits of the more expensive wheelchairs, before they could justify the cost.

The first study probed the NPPD to determine how many wheelchairs and scooters were provided to veterans by the VHA during Federal fiscal years 1999, 2000, and 2001. Demographic (age, gender, race/ethnicity, service category, and priority group) and clinical information (diagnosis and number of comorbidities) of veterans who received wheelchairs and scooters were obtained by linking the NPPD with the NPCD.

Wheelchairs were sorted according to eight types. There were four types of manual wheelchairs: the standard depot wheelchair, the lightweight rehabilitation wheelchair, the highly customizable ultralight wheelchair, and a miscellaneous category with a large percentage of bariatric wheelchairs. There were three types of power wheelchairs: the standard power wheelchair, a miscellaneous category with a large percentage of folding power wheelchairs, and the custom power wheelchair. The eighth category was scooters. When all wheelchairs were considered, the standard manual depot chair was the most frequently prescribed wheelchair for all diagnoses. Lightweight rehabilitation wheelchairs were the second most frequently prescribed wheelchairs for

veterans with MS, SCI, stroke, TBI, PD, and amputee; scooters were the second most frequently prescribed wheeled mobility device for veterans with ALS, COPF/CHF, and arthritis. When only manual wheelchairs were considered, the standard manual depot chair and lightweight rehabilitation wheelchairs were still the first and second most frequently prescribed wheelchairs for all diagnoses including SCI. When only power wheelchairs were considered, the standard power wheelchair was the most frequently prescribed for all diagnoses.

The hypothesis postulated the type of wheelchair provided would differ significantly according to gender, race/ethnicity, and age. No significant differences were found for gender. Differences were more evident between Hispanics and Caucasians than between African Americans and Caucasians. When comparing manual wheelchairs, Hispanics (Odds Ratio=1.7), African Americans (Odds Ratio =1.1), and American Indians & Asians (Odds Ratio =1.6) were more likely than Caucasians to receive manual depot wheelchairs, and Hispanics were more likely than Caucasians to receive ultralight manual (Odds Ratio=1.8). Hispanics (Odds Ratio =0.7) and African Americans (Odds Ratio =0.8) were less likely than Caucasians to receive lightweight rehabilitation wheelchairs. When comparing power wheelchairs Hispanics (Odds Ratio=1.6) were more likely than Caucasians to receive custom power chairs. When comparing all WMDs, older veterans were more likely to receive standard depot wheelchairs ($p < .0001$) and younger veterans ultralight wheelchairs ($p < .0001$).

The second study investigated the variance in the cost of wheelchairs and scooters by VISN (hypothesis 1) and vendor (hypothesis 2). During FY00 and FY01, the VHA provided over 131,000 wheelchairs and scooters, at a cost of \$109,010,198. Of this \$109

million, \$7,747,405 exceeded an established threshold, and was determined by this study to be potential excessive cost. At least part of this variation is attributed to lack of standardization of prosthetic purchase procedures and data entry within the VHA. Another consideration is the possibility of fraud and abuse, which merits further investigation, but was beyond the scope of this study.

The third study linked NPPD data with SF-36V data, to document the relationship between adjustable versus nonadjustable wheelchairs and HRQoL. The first hypothesis postulated controlling for diagnosis, number of comorbidities, and demographic factors, veterans who are provided with more adjustable thus customizable manual and power wheelchairs will report more participation in society. The second hypothesis, based on the assumption that as the HRQoL of the wheelchair user declines, more demand is placed on the technology to maintain user function and participation [1], postulated veterans with poorer HS will be provided with more adjustable and customizable manual and power wheelchairs.

The results indicated veterans who received adjustable, ultralight manual wheelchairs had significantly lower physical function scores, as measured by the SF-36V, and significantly higher mental function, general health, and mental component summary scores than veterans who received nonadjustable, depot chairs, when adjusting for clinical and demographic factors. Interestingly, according to the univariate analyses, veterans who received adjustable manual chairs reported significantly lower physical function, but significantly less role limitation due to physical problems.

The evidence for an association between an adjustable wheelchair and higher mental function was stronger than the evidence for an association between an adjustable

wheelchair and lower physical function. Factors effecting provision of adjustable wheelchairs to patients with higher mental function include the inability of the lower functional patient to self-advocate, clinician bias, and safety considerations. The weak association between the provision of adjustable wheelchairs to patients with lower physical function may have been effected by the relatively few adjustable wheelchairs provided to veterans by the VHA.

5.1.1 Policy Implications

The mission of the VHA is to provide equitable, standardized, and quality care to veterans. This dissertation research has investigated the equity of WMD provision in three contexts: demographic factors, cost, and HS.

There was more variation by ethnicity than by race, no significant variation by gender, and minimal variation by age. When all WMDs were analyzed, Caucasians were more likely to receive power devices including scooters, and minorities were more likely to receive manual wheelchairs. When manual and power devices were analyzed separately, Hispanics were more likely than Caucasians to receive adjustable thus customizable devices with little variation between African Americans and Caucasians. Further investigation is warranted before conclusions can be drawn. For example, the above analyses could be repeated at the VAMC facility level, including facilities with a high volume of adjustable manual and power chair prescriptions.

Lack of standardization in the procedure by which prosthetic devices are entered into the NPPD was found in this and other studies [2, 3]. It is difficult to evaluate standardization of care when the data is inconsistent, i.e. “Is it the care that is inconsistent, the data, or both”? The VHA has a head start in monitoring of prescription

practices, in development of the NPPD, even if the system reliability and validity could be improved as recommended in this dissertation research, primarily in Chapter 3.

The NPPD has the capacity to monitor quality of care i.e. by linking the NPPD with VHA outcomes databases. This dissertation research linked the NPPD to the SF-36V data of the VHS. Evidence can thus be generated in support of the use of AT to improve the quality of life of veterans. The findings of this research presented a stronger association between an adjustable wheelchair and higher mental function than an adjustable wheelchair and lower physical function. In addition, findings provided encouragement to continue to explore the relationship between AT and functional outcomes using a variety of outcomes measures. By linking the NPPD with other databases, quality of care can be monitored through the complete continuum of care: from onset in the acute records of the NPCD, through outpatient care, in the NPCD, associating outcomes with AT devices through the various changes in patient environment as the veteran progresses through the rehabilitation process.

In summary the NPPD, in spite of its shortcomings, provides researchers an excellent opportunity to study the effect of ATDs on rehabilitation outcomes, which in turn can support the mission of the VHA by facilitating standardized and equitable practice, while providing the best care possible to veterans.

5.1.2 Limitations and Future Work

Three categories of limitations of this dissertation research were noted. The first was the more general limitation of using administrative databases in research. Administrative databases “are the by-product of running a healthcare system” [4] and do not provide information unique to each veteran. The implications of this limitation are

many. Evidence was provided for the type, number, cost, etc. of devices provided across VISNs, diagnoses, age, gender, race/ethnicities. However, we do not know how each veteran differed according to level of impairment and disability, functional levels, or mobility, activity, and participation needs. For example, we know how many veterans with a stroke were prescribed a wheelchair, what type, and the cost incurred. We do not know whether the veteran had a mild stroke and lived alone in his own home or had a massive brain stem stroke and lived in a VHA skilled nursing facility. Therefore the appropriateness of the wheelchair prescription cannot be determined.

Not only do medical administrative databases not provide information on patients, they do not provide information on the circumstances under which the devices were prescribed. The background and training of individuals prescribing the devices is an important factor. In a study of SCI Centers of Excellence, Hunt et. al [5] found substantially different wheelchair prescription practices than were found in this dissertation research. These limitations however, lay the foundation for future research. It is not enough to know one VISN provided wheelchairs at a lower cost than other VISNS. Future studies need to investigate which wheelchairs provide the best quality of life for which veterans, what is a reasonable cost for the most appropriate wheelchair, what clinician training is necessary before these decisions can be made, and how can the VHA disseminate this information to impact equality of care.

The second category of limitation included reliability and validity limitations of the NPPD data itself. Inconsistent coding of vendors and devices noted in this and other NPPD studies [2, 3] and discussed extensively in this dissertation effected the accuracy of

quantity and types of devices reported. Standardization of data entry is recommended to improve reliability and validity for future NPPD studies.

The distribution of the cost data was not normal and extremely skewed which limited the statistical analyses that could be performed and the inferences that could be made. At least part of this variation is attributed to lack of standardization of prosthetic purchase procedures and data entry within the VHA. Another consideration is the possibility of fraud and abuse, which merits further investigation, but was beyond the scope of this study.

The third category of limitation was variance in the data resulting from differences in wheelchair provision practices across facilities. Standardization of data entry is not the same as standardization of prescription practices. Ideally, standardized data entry would provide options for differentiating the various wheelchair provision options and processes so they could be compared and contrasted. Unfortunately, lack of opportunities to code for these various options (an asset to the VHA system) further jeopardizes reliability and validity. If there was standardization in documenting how the device was provided, (i.e. from stock with adjustment from VHA technician versus supplied and adjusted by vendor) future studies could identify and rank the most effective VHA purchase options for WMDs.

Variation in wheelchair prescription practices remains unknown as this data is not included in the NPPD, an administrative database, yet prescription practice is an important factor to consider before drawing conclusions from the results of this study. Potential excessive cost can be partially explained by a facility with a specialty clinic that provides wheelchairs to veterans with challenging seating and mobility needs (i.e. SCI,

tetraplegia, and MS) versus a VAMC that prescribes primarily scooters to veterans with deconditioning disorders. It is possible that VAMC facilities with wheelchair costs below the national median may not be adequately meeting the seating and mobility needs of veterans. Once clinical guidelines on manual and power wheelchair prescription within the VHA are finalized and distributed, future studies could incorporate guidelines as a factor along with wheelchair prescription and functional level.

Other ways future studies could build on this dissertation research include the following. The NPPD could be linked with other VHA databases, i.e. the Functional Status Outcome Database (FSOD) [6]. Prospective studies could be designed to use other measures functional outcomes. i.e. that follow the World Health Organization (WHO) [7], International Classification of Function (ICF) [8] model. Exploration of alternative outcomes measures could lead to expansion of existing VHA outcomes database(s). VACO has expressed interest in establishing outcomes for veterans with amputations. Outcomes databases exist for individuals with SCI. The VHA maintains an outcomes database for veterans with stroke. It is recommended that these databases be consolidated, or have the capacity to be integrated by the use of common fields. Otherwise orthopedic function will be contained in one database, neurological function in another, and cognitive function in yet another. This could be problematic for a veteran with SCI and a blast injury resulting in amputation. In addition, maintaining databases by body impairment goes against the prevailing rehabilitation model where individuals with disabilities are viewed in an activity and participation outcomes context rather than in an impairment context.

As a final recommendation for future work, more variance among manual wheelchair recipients was found in both the demographic (race/ethnic variance) and the HRQoL (HS) studies than for power wheelchair recipients. Future studies could further explore the implication of this finding, for example, do power wheelchairs require more clinical expertise in seating and mobility than standard manual wheelchairs? Do power wheelchairs require more clinical expertise in seating and mobility than standard manual wheelchairs? Thus, there is less variance in provision. Or is it because fewer power wheelchairs are provided? Or is there less variance in the characteristics of veterans who receive power chairs, i.e. is the spectrum narrower?

In conclusion, the NPPD, developed to provide a better understanding of the relationship between quality, function, and cost [9], is a valuable and promising source of prosthetic data. This research provided three snapshots of the VHA WMD provision system: demographics, cost, and HRQoL of veterans who receive wheelchairs from the VHA. The next steps are (1) to improve the quality of the data by standardizing NPPD data entry, and (2) to design future studies to develop these uni-dimensional snapshots into multidimensional relationships that can provide evidence in support of the provision of AT to improve the quality of life for veterans, and contribute to the develop of practice guidelines for the prescription of AT devices.

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APPENDIX A

HCPCS Code and Corresponding Assigned Wheelchair Type

HCPCS Codes with Corresponding NPPD Line and WC Type			
HCPCS Code	Description	NPPD Line	WC Type
E1050	W/c reclining fxd arms	100 B	M1
E1060	W/c detachable arms	100 B	M1
E1070	W/c detachable foot r	100 B	M1
E1083	Hemi w/c fixed arms	100 B	M1
E1084	Hemi w/c detachable a	100 B	M1
E1085	Hemi w/c fixed arms	100 B	M1
E1086	Hemi w/c detachable a	100 B	M1
E1087	W/c lightwt fixed arm	100 B	M2
E1088	W/c lightweight det a	100 B	M2
E1089	W/c lightwt fixed arm	100 B	M2
E1090	W/c lightweight det a	100 B	M2
E1091	W/c youth	100 B	M4
E1092	W/c wide/w leg rests	100 B	M4
E1093	W/c wide/w foot rest	100 B	M4
E1100	W/c s-recl fxd arm leg res	100 B	M1
E1110	W/c semi-recl detach	100 B	M1
E1130	W/c stand det arm ft rest	100 C	M1
E1140	W/c standard detach a	100 C	M1
E1150	W/c standard w/ leg r	100 C	M1
E1160	W/c fixed arms	100 C	M1
E1170	W/c amp fxd arm leg rest	100 B	M1
E1171	W/c amputee w/o leg r	100 B	M1
E1172	W/c amputee /detach ar	100 B	M1
E1180	W/c amputee w/ foot r	100 B	M1
E1190	W/c amputee w/ leg re	100 B	M1
E1195	W/c amputee heavy dut	100 B	M1
E1200	W/c amputee fixed arm	100 B	M1
E1210	W/c motorfxd arm leg rest	100 A	P1
E1211	W/c motorized w/ det	100 A	P1
E1212	W/c motorized w full	100 A	P1
E1213	W/c motorized w/ det	100 A	P1
E1220	W/c special size/constrc	100 B	P1
E1221	W/c spec size w foot	100 B	M4
E1222	W/c spec size w/ leg	100 B	M4
E1223	W/c spec size w foot	100 B	M4
E1224	W/c spec size w/ leg	100 B	M4
E1225	W/c spec sz semi-recl	100 B	M4

HCPCS

Code	Description	NPPD Line	WC Type
E1226	W/c spec sz full-recl	100 B	M4
E1227	W/c spec spec sz spec ht A	100 B	M4
E1228	W/c spec spec sz spec ht B	100 B	M4
E1230	Powered operated vehicle	100 A1	S1
E1240	W/c litwt det arm leg rest	100 B	M1
E1250	W/c lightwt fixed arm	100 B	M1
E1260	W/c lightwt foot rest	100 B	M1
E1270	W/c lightweight leg r	100 B	M1
E1280	W/c h-duty det arm leg res	100 B	M1
E1285	W/c heavy duty fixed	100 B	M1
E1290	W/c hvy duty detach a	100 B	M1
E1295	W/c heavy duty fixed	100 B	M1
E1296	W/c special seat heig	100 B	M1
E1297	W/c special seat dept	100 B	M1
E1298	W/c spec seat depth/w	100 B	M1
K0001	Standard wheelchair	100 C	M1
K0002	Std hemi (low seat) w/c	100 B	M1
K0003	Lightweight wheelchair	100 B	M2
K0004	High strength ltwt whlchr	100 B	M2
K0005	Ultralightweight wheelchair	100 B	M3
K0006	Heavy duty wheelchair	100 B	M4
K0007	Extra heavy duty wheelchair	100 B	M4
K0008	Custom manual wheelchair/base	100 B	M4
K0009	Other manual wheelchair base	100 B	M4
K0010	Std wt frame power w/c	100 A	P1
K0011	Std wt pwr whlchr w control	100 A	P2
K0012	Ltwt portbl power whlchr	100 A	P2
K0013	Custom motorized/power wheelchair base	100 A	P3
K0014	Other power whlchr base	100 A	P3

APPENDIX B

SAS Code Chapter 2 Demographic Study Hypothesis Analyses

Logistic Regression

```
/*I need some data
I made a copy of H1_boni_c and will edit it to get logistic regression
data
for dissertation revision - scooter and power Table 15
Jene 26, 2004*/
/*two data sets
  manual = 150553 obs
else if power manual=0*/
proc logistic data=bonipow descending;
  class rac(param=ref ref='6') dxp(param=ref ref='11') male(param=ref
ref='0') ;
  model scoot = dxp numco age year male rac / stb;
  units age=10/default=1;
  contrast 'hispanic vs. white' rac 1 0 0 /estimate=exp;
  contrast 'amaian vs. white' rac 0 1 0 /estimate=exp;
  contrast 'black vs. white' rac 0 0 1 /estimate=exp;
  /*selection=stepwise include=1*/;
run;quit;
proc logistic data=dog5 descending;
  /*class male (param=ref ref='1') dxp (param=ref ref='11') rac
(param=ref ref='6');*/
  model power= als ms scit scip stroke pd ampu copd arthri
numco age year male hispanic amai black otherrac / stb
  /*selection=stepwise include=1*/;
run;quit;
proc logistic data=dog5 descending;
  /*class male (param=ref ref='1') dxp (param=ref ref='11') rac
(param=ref ref='6');*/
  model power= als ms scit scip stroke pd ampu copd arthri
numco age year male hispanic amai black otherrac / stb
  /*selection=stepwise include=1*/;
run;quit;
/*take scooter out of power
bonipow was = 40515 records*/
data bonipow2; /*dropped to 16160 records, over 50% about right*/
set bonipow;
if scoot = 1 then delete;
run;
proc logistic data=bonipow2 descending;
  class rac(param=ref ref='6') dxp(param=ref ref='11') male(param=ref
ref='0') ;
  model powcus = dxp numco age year male rac / stb;
  units age=10/default=1;
  contrast 'hispanic vs. white' rac 1 0 0 /estimate=exp;
  contrast 'amaian vs. white' rac 0 1 0 /estimate=exp;
  contrast 'black vs. white' rac 0 0 1 /estimate=exp;
  /*selection=stepwise include=1*/;
run;quit;
```

```

proc logistic data=bonipow2 descending;
  /*class male (param=ref ref='1') dxp (param=ref ref='11') rac
  (param=ref ref='6');*/
  model powcus= als ms scit scip stroke pd ampu copd arthri
  numco age year male hisp amai black otherrac / stb
  /*selection=stepwise include=1*/;
run;quit;
/*run model collapsing power + scooter*/
data dog5;
set dog4;
if dxp=1 then als=1; else als=0;
if dxp=2 then ms=1; else ms=0;
if dxp=3 then scit=1; else scit=0;
if dxp=4 then scip=1; else scip=0;
if dxp=5 then stroke=1; else stroke=0;
if dxp=7 then pd=1; else pd=0;
if dxp=8 then ampu=1; else ampu=0;
if dxp=9 then copd=1; else copd=0;
if dxp=10 then arthri=1; else arthri=0;
if dxp=11 then otherdx=0; /*reference*/
if rac=1 then hisp = 1; else hisp = 0;
if rac=3 then amai = 1; else amai = 0;
if rac=4 then black = 1; else black = 0;
if rac=6 then white = 0;
if rac=7 then otherrac = 1; else otherrac = 0;
run;
/*create variables for manual and power*/
data dog3;
set dog2;
if wctype=1 then manual=1;
else if wctype=2 then manual=1;
else if wctype=3 then manual=1;
else if wctype=4 then manual=1;
else manual =0;
if wctype=5 then power=1;
else if wctype=6 then power=1;
else if wctype=7 then power=1;
else power=0;
if wctype=8 then scooter=1;
else scooter=0;
run;
data dog4;
set dog3;
if scooter=1 then output dog4;
else if power=1 then output dog4;
run;
data dog2;
set dog;
if dxp=1 then als=1; else als=0;
if dxp=2 then ms=1; else ms=0;
if dxp=3 then scit=1; else scit=0;
if dxp=4 then scip=1; else scip=0;
if dxp=5 then stroke=1; else stroke=0;
if dxp=7 then pd=1; else pd=0;
if dxp=8 then ampu=1; else ampu=0;
if dxp=9 then copd=1; else copd=0;
if dxp=10 then arthri=1; else arthri=0;

```

```

if dxp=11 then otherdx=0; /*reference*/
if rac=1 then hisp = 1; else hisp = 0;
if rac=3 then amai = 1; else amai = 0;
if rac=4 then black = 1; else black = 0;
if rac=6 then white = 0;
if rac=7 then otherrac = 1; else otherrac = 0;
run;
proc logistic data=powscoot3 descending;
    /*class male (param=ref ref='1') dxp (param=ref ref='11') rac
    (param=ref ref='6');*/
    model power= als ms scit scip stroke pd ampu copd arthri
    numco age year male hisp amai black otherrac / stb
    /*selection=stepwise include=1*/;
run;quit;
data cat3;
year=3;
set disser.demo_type01adj_age2_dxp2 /*disserr.demo_type00adj_age2_dxp2
disserr.demo_type01adj_age2_dxp2*/;
run;
data dog;
set cat1 cat2 cat3;
run;

```

APPENDIX C

SAS Code Chapter 3 Selection and Validation of Cut-Off Points for Low Outliers

hcpcs	description	SAS proc freq results				Cut-off calculations					
		freq	%	Cum freq	Cum %	10%	50%	logical cut-off	%excluded cut-off	75%	100%
E1050	reclining std/fixd arm	85	0.07	85	0.07	\$59	\$400	\$100	11.76%	\$794	\$4,778
E1060	std/detach arm	985	0.81	1070	0.88	\$118	\$322	\$100	7.61%	\$609	\$8,716
E1070	std/detach foot	1323	1.09	2393	1.97	\$36	\$159	\$100	26.23%	\$249	\$3,775
E1083	hemi/fixd arm	21	0.02	2414	1.99	\$32	\$378	\$100	19.05%	\$471	\$668
E1084	hemi/detach arm	54	0.04	2468	2.03	\$158	\$416	\$100	1.85%	\$617	\$1,623
E1086	hemi/detach arm	45	0.04	2513	2.07	\$232	\$385	\$100	2.22%	\$600	\$3,015
E1087	lt weight/fixd arm	143	0.12	2656	2.18	\$144	\$331	\$200	3.50%	\$650	\$2,573
E1088	lt weight/detach arm	1148	0.94	3804	3.13	\$240	\$430	\$200	6.97%	\$842	\$10,565
E1089	lt weight/fixd arm	73	0.06	3877	3.19	\$113	\$466	\$200	20.55%	\$763	\$4,778
E1090	lt weight/detach arm	493	0.41	4370	3.59	\$250	\$538	\$200	6.40%	\$966	\$11,067
E1092	wide/w leg rest	78	0.06	4448	3.66	\$56	\$399	\$100	11.54%	\$452	\$2,799
E1093	wide/w foot rest	78	0.06	4526	3.72	\$200	\$363	\$100	5.13%	\$506	\$4,315
E1100	semi rec/detach arm	80	0.07	4606	3.79	\$106	\$591	\$100	8.75%	\$1,138	\$11,686
E1110	semi rec/fixd arm&leg	259	0.21	4865	4.00	\$286	\$693	\$100	3.47%	\$1,377	\$6,958
E1130	std/detach arm&foot	607	0.50	5472	4.50	\$107	\$145	\$100	7.25%	\$202	\$1,705
E1140	std/detach arm	2658	2.19	8130	6.69	\$115	\$167	\$100	8.16%	\$192	\$7,057
E1150	std/w leg rest	1569	1.29	9699	7.98	\$70	\$201	\$100	11.79%	\$256	\$9,186
E1160	std/fixd arms	151	0.12	9850	8.10	\$112	\$159	\$100	8.61%	\$299	\$5,544
E1171	amp/wo leg rest	30	0.02	9880	8.12	\$29	\$280	\$100	20.00%	\$660	\$1,925
E1172	amp/detach arm	127	0.10	10007	8.23	\$115	\$326	\$100	6.30%	\$855	\$2,942
E1180	amp/w foot rest	86	0.07	10093	8.30	\$203	\$379	\$100	4.65%	\$385	\$1,400
E1190	amp/w leg rest	165	0.14	10258	8.44	\$160	\$237	\$100	0.61%	\$352	\$3,000
E1195	amp heavy duty	48	0.04	10306	8.48	\$304	\$615	\$100	2.08%	\$1,406	\$3,119
E1200	amp/fixd arm	51	0.04	10357	8.52	\$119	\$139	\$100	7.84%	\$295	\$3,072
E1210	power/arm leg rest	74	0.06	10431	8.58	\$1,688	\$3,594	\$1,000	6.76%	\$5,527	\$12,915

E1211 power/w detach		1357	1.12	11788	9.69	\$1,672	\$3,732	\$1,000	6.56%	\$5,180	\$19,412
		SAS proc freq results				Cut-off calculations					
hcpcs	description	freq	%	Cum freq	Cum %	10%	50%	logical cut-off	%excluded cut-off	75%	100%
E1212	power/w full	1245	1.02	13033	10.72	\$1,132	\$4,000	\$1,000	9.48%	\$4,963	\$17,729
E1213	power/w detach	382	0.31	13415	11.03	\$1,693	\$3,506	\$1,000	4.97%	\$4,959	\$20,040
E1220	spec size/construction	249	0.20	13664	11.24	\$25	\$891	\$100	16.47%	\$1,798	\$12,315
E1221	manual/spec size w foot	131	0.11	13795	11.34	\$156	\$639	\$100	4.58%	\$1,077	\$9,053
E1222	manual/spec size w leg	42	0.03	13837	11.38	\$219	\$639	\$100	4.76%	\$1,128	\$1,901
E1223	manual/spec size w foot	274	0.23	14111	11.60	\$124	\$177	\$100	7.30%	\$240	\$9,357
E1224	manual/spec size w leg	20	0.02	14131	11.62	\$142	\$385	\$100	0.00%	\$920	\$2,200
E1225	manual/spec size semi recl	38	0.03	14169	11.65	\$96	\$1,070	\$100	10.53%	\$1,470	\$4,603
E1226	manual/spec size full recl	240	0.20	14409	11.85	\$394	\$497	\$100	3.75%	\$690	\$15,537
E1227	manual/spec size	21	0.02	14430	11.87	\$96	\$945	\$100	4.76%	\$1,113	\$1,694
E1228	manual/spec size	25	0.02	14455	11.89	\$177	\$349	\$100	0.00%	\$511	\$2,162
E1230	scooter	15546	12.78	30001	24.67	\$1,235	\$1,910	\$900	5.31%	\$2,240	\$17,883
E1240	lt weight/swing arm	416	0.34	30417	25.01	\$44	\$345	\$200	24.04%	\$475	\$4,313
E1250	lt weight/swing foot	65	0.05	30482	25.07	\$6	\$445	\$200	18.46%	\$600	\$3,524
E1260	lt weight/swing foot	1345	1.11	31827	26.17	\$132	\$237	\$200	38.36%	\$338	\$3,090
E1270	lt weight/swing elev foot	318	0.26	32145	26.43	\$49	\$370	\$200	14.78%	\$683	\$3,391
E1280	heavy duty/ elev leg	166	0.14	32311	26.57	\$144	\$524	\$100	8.43%	\$1,623	\$3,596
E1285	heavy duty/ swing detach foot	254	0.21	32565	26.78	\$295	\$612	\$100	1.97%	\$1,116	\$9,871
E1290	heavy duty/ swing detach foot	533	0.44	33098	27.22	\$195	\$541	\$100	5.63%	\$1,100	\$5,768
E1295	heavy duty/ elev foot	68	0.06	33166	27.27	\$96	\$563	\$100	10.29%	\$755	\$5,905
E1296	spec height	72	0.06	33238	27.33	\$150	\$400	\$100	6.94%	\$621	\$5,214
E1297	spec depth	44	0.04	33282	27.37	\$48	\$315	\$100	13.64%	\$599	\$3,220
E1298	spec depth width	166	0.14	33448	27.51	\$172	\$782	\$100	3.01%	\$1,213	\$4,757
K0001	std wheelchair	45657	37.55	79105	65.05	\$119	\$162	\$100	4.88%	\$198	\$13,667
K0002	std hemi	485	0.40	79590	65.45	\$155	\$353	\$100	5.36%	\$467	\$3,665
K0003	lightweight high strength	9075	7.46	88665	72.91	\$184	\$352	\$100	3.33%	\$486	\$9,045
K0004	lightweight	16466	13.54	105131	86.46	\$228	\$350	\$200	6.97%	\$493	\$12,346

		3384	2.78	108515	89.24	\$422	\$1,030	\$400	10.58%	\$1,305	\$11,514
		SAS proc freq results				Cut-off calculations					
hcpcs	description	freq	%	Cum freq	Cum %	logical		%excluded		75%	100%
						10%	50%	cut-off	cut-off		
K0005	ultralight										
K0006	heavy duty	2418	1.99	110933	91.23	\$232	\$441	\$100	3.60%	\$630	\$9,843
K0007	extra heavy duty	1366	1.12	112299	92.35	\$292	\$488	\$100	3.22%	\$785	\$9,594
K0008	custom manual base	1173	0.96	113472	93.32	\$218	\$801	\$200	8.95%	\$1,289	\$10,422
K0009	other manual base	694	0.57	114166	93.89	\$146	\$600	\$100	3.75%	\$1,368	\$9,604
K0010	std power	1021	0.84	115187	94.73	\$726	\$2,700	\$1,000	10.97%	\$3,844	\$18,189
K0011	std power/prog control	2939	2.42	118126	97.14	\$1,739	\$3,750	\$1,000	6.67%	\$4,868	\$25,851
K0012	lt weight folding power	854	0.70	118980	97.84	\$349	\$1,891	\$1,000	13.35%	\$2,780	\$15,389
K0013	custom power base	726	0.60	119706	98.44	\$1,862	\$4,337	\$1,000	7.02%	\$6,866	\$22,864
K0014	other power base	1895	1.56	121601	100.00	\$1,750	\$4,317	\$1,000	7.18%	\$6,370	\$24,459

APPENDIX D

SAS Code Chapter 3 Cost Study Vendor Name Edit

```
/*Clean up vendor names*/
data cutoff2;
set disser.cutoff2;
run;
proc sort data=cutoff2;
by vendor;
run;
proc sort data=cut28 out=cut30;
by vendor;
run;
/*data vendor;
set cutoff2;
by vendor;
if FIRST.VENDOR=1 THEN OUTPUT;
run;*/
data vendora;
set cut30;
  vendor=COMPRESS(vendor, '**');/*delete leading '**' */
  put vendor;
run;
data vendorb;
set vendora;
if substr(vendor,1,23) = "21st Century Scientific"
  then vendor= "21ST CENTURY SCIENTIFIC";
  if substr(vendor,1,12) = "21ST CENTURY"
  then vendor= "21ST CENTURY SCIENTIFIC";
  if substr(vendor,1,12) = "21st CENTURY"
  then vendor= "21ST CENTURY SCIENTIFIC";
  put vendor;
run;
data vendorc;
set vendorb;
if substr(vendor,1,16) = "ABBA WHEELCHAIRS"
  then vendor= "ABBA WHEELCHAIRS";
  put vendor;
run;
data vendord;
set vendorc;
if substr(vendor,1,8) = "ABLE MED"
  then vendor= "ABLE MEDICAL AIDS";
  put vendor;
run;
data vendore;
set vendord;
if substr(vendor,1,11) = "ACCELERATED"
  then vendor= "ACCELERATED REHAB DESIGNS INC";
  put vendor;
if substr(vendor,1,10) = "ACCESS & M"
```

```

    then vendor= "ACCESS AND MOBILITY PRODUCTS";
    put vendor;
    run;
data vendorf;
set vendore;
if substr(vendor,1,20) = "ACCESSIBLE VEHICLES"
    then vendor= "ACCESSIBLE VEHICLES OF LEXINGTON"; /*ALL visn 9*/
    put vendor;
if substr(vendor,1,14) = "ACCESS AND MOB"
    then vendor= "ACCESS AND MOBILITY PRODUCTS";
    put vendor;
    run;
data vendorg;
set vendorf;
if substr(vendor,1,20) = "ACCESS TO RECREATION"
    then vendor= "ACCESS TO RECREATION";
    put vendor;
if substr(vendor,1,7) = "ACS MOB"
    then vendor= "ACS MOBILITY";
    put vendor;
    run;
data vendorh;
set vendorg;
if substr(vendor,1,17) = "ADAPTIVE MOBILITY"
    then vendor= "ADAPTIVE MOBILITY";
    put vendor;
if substr(vendor,1,15) = "ADAPTIVE SWITCH"
    then vendor= "ADAPTIVE SWITCH LABS";
    put vendor;
    run;
data vendork;
set vendorh;
if substr(vendor,1,13) = "ADVANCED CARE"
    then vendor= "ADVANCED CARE INC"; /*ALL VISN 3*/
    put vendor;
if substr(vendor,1,21) = "ADVANCED MOBILITY INC"
    then vendor= "ADVANCED MOBILITY";
    put vendor;
if substr(vendor,1,22) = "ADVANCED MOBILITY INC."
    then vendor= "ADVANCED MOBILITY";
    put vendor;
    run;
data vendorL;
set vendork;
if substr(vendor,1,7) = "ALI MED"
    then vendor= "ALIMED INC";
    put vendor;
if substr(vendor,1,6) = "ALIMED"
    then vendor= "ALIMED INC";
    put vendor;
    run;
data vendorm;
set vendorL;
if substr(vendor,1,19) = "ALTERNATIVE MEDICAL"
    then vendor= "ALTERNATICE MEDICAL INC";
    put vendor;
if substr(vendor,1,16) = "ALTIMATE MEDICAL"

```

```

    then vendor= "ALTIMATE MEDICAL INC";
  put vendor;
run;
data vendorN;
set vendorM;
if substr(vendor,1,18) = "AFTER MARKET GROUP"
  then vendor= "AFTER MARKET GROUP";
  run;
data vendoro;
set vendorn;
if substr(vendor,1,19) = "ALTERNATICE MEDICAL"
  then vendor= "ALTERNATIVE MEDICAL INC";
  put vendor;
run;
data vendorP;
set vendorO;
if substr(vendor,1,19) = "ALTERNATICE MEDICAL"
  then vendor= "ALTERNATIVE MEDICAL INC";
  put vendor;
if substr(vendor,1,22) = "AMERICAN MEDICAL DEPOT"
  then vendor= "AMERICAN MEDICAL DEPOT";
  put vendor;
if substr(vendor,1,23) = "AMERICAN MEDICAL RENTAL"
  then vendor= "AMERICAN MEDICAL RENTAL & SUPPLY";
  put vendor;
run;
data vendorQ;
set vendorp;
if substr(vendor,1,17) = "AMERICAN SURGICAL"
  then vendor= "AMERICAN SURGICAL CORP";
  put vendor;
if substr(vendor,1,5) = "AMIGO"
  then vendor= "AMIGO MOBILITY";
  put vendor;
if substr(vendor,1,13) = "AMJ MEDICAL M"
  then vendor= "AMJ MEDICAL MANAGEMENT LLC";
  put vendor;
run;
data vendorqq;
set vendorq;
if substr(vendor,1,11) = "AFTERMARKET"
  then vendor= "AFTER MARKET GROUP";
  if substr(vendor,1,12) = "AFTER MARKET"
  then vendor= "AFTER MARKET GROUP";
  if substr(vendor,1,4) = "ALCO"
  then vendor= "ALCO SALES & SERVICE";
  if substr(vendor,1,22) = "AMERICAN MEDICAL DEPOT"
  then vendor= "AMERICAN MEDICAL DEPOT";
  if substr(vendor,1,23) = "AMERICAN MEDICAL RENTAL"
  then vendor= "AMERICAN MEDICAL RENTAL";
  put vendor;
run;
data vendorR;
set vendorQQ;
if substr(vendor,1,16) = "BODYPOINT DESIGN"
  then vendor= "BODYPOINT DESIGN INC";
  put vendor;

```

```

if substr(vendor,1,5) = "BRIKE"
  then vendor= "BRIKE INTERNATIONAL";
put vendor;
if substr(vendor,1,5) = "BRODA"
  then vendor= "BRODA";
put vendor;
if substr(vendor,1,11) = "BRUNO INDEP"
  then vendor= "BRUNO INDEPNDENT LIVING AIDS";
put vendor;
if substr(vendor,1,5) = "C & W"
  then vendor= "C W HEALTHCARE";
put vendor;
if substr(vendor,1,15) = "C W HEALTH CARE"
  then vendor= "C W HEALTHCARE";
put vendor;
run;
data vendorS;
set vendorR;
if substr(vendor,1,11) = "CANYON PROD"
  then vendor= "CANYON PRODUCTS";
put vendor;
if substr(vendor,1,11) = "CARING RESP"
  then vendor= "CARING RESPIRATORY";
put vendor;
if substr(vendor,1,15) = "CENTRAL ALABAMA"
  then vendor= "CENTRAL ALABAMA MOBILITY";
put vendor;
if substr(vendor,1,23) = "CENTRAL OHIO WHEELCHAIR"
  then vendor= "CENTRAL OHIO WHEELCHAIR";
put vendor;
if substr(vendor,1,8) = "CHARLTON"
  then vendor= "CHARLTON MOBILITY";
put vendor;
if substr(vendor,1,16) = "CHESAPEAKE REHAB"
  then vendor= "CHESAPEAKE REHAB EQUIP";
put vendor;
if substr(vendor,1,7) = "COLOURS"
  then vendor= "COLOURS";
put vendor;
run;
data vendorT;
set vendorS;
if substr(vendor,1,17) = "COMMONWEALTH HOME"
  then vendor= "COMMONWEALTH HOME HEALTH CARE";
put vendor;
if substr(vendor,1,11) = "COUNTRY HEALTH"
  then vendor= "COUNTRY HEALTH INC";
put vendor;
if substr(vendor,1,4) = "COP2"
  then vendor= "COP2 INC";
put vendor;
if substr(vendor,1,5) = "CROWN"
  then vendor= "CROWN THERAPEUTICS INC";
put vendor;
if substr(vendor,1,15) = "CUSTOM MOBILITY"
  then vendor= "CUSTOM MOBILITY INC";
put vendor;

```

```

if substr(vendor,1,16) = "Chesapeake Rehab"
  then vendor= "CHESAPEAKE REHAB EQUIP";
put vendor;
if substr(vendor,1,7) = "Colours"
  then vendor= "COLOURS";
put vendor;
run;
data vendortt;
set vendort;
if substr(vendor,1,12) = "CARE MEDICAL"
  then vendor= "CARE MEDICAL";
if substr(vendor,1,5) = "C & C"
  then vendor= "C&C DIVERSIFIED";
if substr(vendor,1,9) = "CONVAQUIP"
  then vendor= "CONVAQUIP INDUSTRIES";
if substr(vendor,1,5) = "C & W"
  then vendor= "C W HEALTHCARE";
if substr(vendor,1,3) = "C W"
  then vendor= "C W HEALTHCARE";
put vendor;
RUN;
data vendoru;
set vendortt;
if substr(vendor,1,22) = "CRAIG CARTER GOLF CARS"
  then vendor= "Craig Carter Golf Cars Inc";
put vendor;
if substr(vendor,1,6) = "DALTON"
  then vendor= "DALTON MEDICAL CORP";
put vendor;
if substr(vendor,1,14) = "DIVERSIFIED OP"
  then vendor= "DIVERSIFIED OPHTHALMICS INC";
put vendor;
if substr(vendor,1,25) = "DURABLE MEDICAL EQUIPMENT"
  then vendor= "DURABLE MEDICAL EQUIPMENT CO";
put vendor;
if substr(vendor,1,12) = "DURO MED IND"
  then vendor= "DURO MED INDUSTRIES";
put vendor;
if substr(vendor,1,8) = "DURO-MED"
  then vendor= "DURO MED INDUSTRIES";
put vendor;
if substr(vendor,1,5) = "E & J"
  then vendor= "EVERST & JENNINGS";
put vendor;
if substr(vendor,1,5) = "EVERST AND JENNINGS"
  then vendor= "EVERST & JENNINGS";
put vendor;
run;
data vendorV;
set vendorU;
if substr(vendor,1,11) = "EAGLE SPORT"
  then vendor= "EAGLE SPORTCHAIRS";
put vendor;
if substr(vendor,1,10) = "ED MEDICAL"
  then vendor= "ED MEDICAL INC";
put vendor;
if substr(vendor,1,17) = "ELECTRIC MOBILITY"

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```

    then vendor= "ELECTRIC MOBILITY CORP";
put vendor;
if substr(vendor,1,17) = "ELEC MOBILITY CORP"
    then vendor= "ELECTRIC MOBILITY CORP";
put vendor;
if substr(vendor,1,11) = "EMPIRE HOME"
    then vendor= "EMPIRE HOME MEDICAL INC";
put vendor;
if substr(vendor,1,4) = "EPVA"
    then vendor= "EPVA WHEELCHAIR REPAIR";
put vendor;
if substr(vendor,1,3) = "E&J"
    then vendor= "EVERST & JENNINGS";
put vendor;
if substr(vendor,1,5) = "EVEREST AND JENNINGS"
    then vendor= "EVEREST & JENNINGS";
put vendor;
run;
data vendorW;
set vendorV;
    if substr(vendor,1,13) = "ELEC MOBILITY"
        then vendor= "ELECTRIC MOBILITY CORP";
put vendor;
if substr(vendor,1,13) = "Electric Mobility Corporation"
    then vendor= "ELECTRIC MOBILITY CORP";
put vendor;
if substr(vendor,1,12) = "EQUIPMENT CO"
    then vendor= "EQUIPMENT COMPANY UMLIMITED";
put vendor;
if substr(vendor,1,19) = "EVEREST AND JENNING"
    then vendor= "EVEREST & JENNINGS";
put vendor;
if substr(vendor,1,20) = "EVEREST AND JENNINGS"
    then vendor= "EVEREST & JENNINGS";
put vendor;
if substr(vendor,1,19) = "EVERST AND JENNING"
    then vendor= "EVEREST & JENNINGS";
put vendor;
run;
data vendorx;
set vendorw;
if substr(vendor,1,17) = "EVERST & JENNINGS"
    then vendor= "EVEREST & JENNINGS";
put vendor;
if substr(vendor,1,17) = "EVEREST & JENNING"
    then vendor= "EVEREST & JENNINGS";
put vendor;
if substr(vendor,1,18) = "EVEREST & JENNINGS"
    then vendor= "EVEREST & JENNINGS";
put vendor;
if substr(vendor,1,13) = "electric mobility corporation"
    then vendor= "ELECTRIC MOBILITY CORP";
put vendor;
if substr(vendor,1,16) = "chesapeake rehab"
    then vendor= "CHESAPEAKE REHAB EQUIP";
put vendor;
if substr(vendor,1,12) = "ELEC MOBILTY"

```

```

    then vendor= "ELECTRIC MOBILITY CORP";
put vendor;
run;
data vendory;
set vendorx;
if substr(vendor,1,17) = "Electric Mobility"
    then vendor= "ELECTRIC MOBILITY CORP";
    put vendor;if substr(vendor,1,16) = "electric mobility"
    then vendor= "ELECTRIC MOBILITY CORP";
    put vendor;
    if substr(vendor,1,16) = "ELECTRIC MOBILTY"
    then vendor= "ELECTRIC MOBILITY CORP";
put vendor;
if substr(vendor,1,11) = "Empire Home"
    then vendor= "EMPIRE HOME MEDICAL INC";
put vendor;
if substr(vendor,1,12) = "Equipment Co"
    then vendor= "EQUIPMENT COMPANY UMLIMITED";
put vendor;
run;
data vendoryy ;
set vendory ;
if substr(vendor,1,12) = "Craig Carter"
    then vendor= "Craig Carter Golf Cars Inc";
    put vendor;
run;
data vendorZ;
set vendorYy;
if substr(vendor,1,8) = "EVER-MED"
    then vendor= "EVERMED";
    put vendor;
    if substr(vendor,1,6) = "FALCON"
    then vendor= "FALCON REHABILITATION PRODUCTS";
    put vendor;
    if substr(vendor,1,9) = "FAST SERV"
    then vendor= "FASTSERV MEDICAL";
    put vendor;
    if substr(vendor,1,9) = "FASTSERVE"
    then vendor= "FASTSERVE OF ANDERSON";
    put vendor;
run;
data vendorAA;
set vendorZ;
if substr(vendor,1,7) = "GENDROM"
    then vendor= "GENDROM INC";
    put vendor;
if substr(vendor,1,16) = "FLORIDA HOMECARE"
    then vendor= "FLORIDA HOMECARE MEDICAL INC";
    put vendor;
if substr(vendor,1,22) = "electric mobility corp"
    then vendor= "ELECTRIC MOBILITY CORP";
    put vendor;
    if substr(vendor,1,16) = "FASTSERV MEDICAL"
    then vendor= "FASTSERV MEDICAL";
    put vendor;
run;
data vendorAB;

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set vendorAA;
if substr(vendor,1,11) = "GRAHAMFIELD"
  then vendor= "GRAHAM FIELD";
  put vendor;
if substr(vendor,1,12) = "GRAHAM-FIELD"
  then vendor= "GRAHAM FIELD";
  put vendor;
if substr(vendor,1,12) = "GRAHAM FIELD"
  then vendor= "GRAHAM FIELD";
  put vendor;
if substr(vendor,1,14) = "GOLDEN TECHNOL"
  then vendor= "GOLDEN TECHNOLOGIES INC";
  put vendor;
if substr(vendor,1,6) = "GERBER"
  then vendor= "GERBER CHAIRMATES INC";
  put vendor;
if substr(vendor,1,5) = "GENES"
  then vendor= "GENE'S VAN CONVERSION/ INC";
  put vendor;
if substr(vendor,1,7) = "GENDRON"
  then vendor= "GENDRON INC";
  put vendor;
RUN;
data vendorAC;
set vendorAB;
if substr(vendor,1,8) = "HASTINGS"
  then vendor= "HASTINGS HOME HEALTH CENTER";
  put vendor;
if substr(vendor,1,10) = "GULF COAST"
  then vendor= "GULF COAST REHAB EQUIPMENT";
  put vendor;
if substr(vendor,1,10) = "GENE'S VAN"
  then vendor= "GENE'S VAN CONVERSION/ INC";
  put vendor;
  if substr(vendor,1,8) = "GUARDIAN"
  then vendor= "GUARDIAN PRODUCTS";
  put vendor;
RUN;
data vendorAD;
set vendorAC;
if substr(vendor,1,7) = "HERMELL"
  then vendor= "HERMELL PRODUCTS INC";
  put vendor;
if substr(vendor,1,4) = "HILL"
  then vendor= "HILL ROM INC";
  put vendor;
if substr(vendor,1,9) = "HOVEROUND"
  then vendor= "HOVEROUND CORP";
  put vendor;
  if substr(vendor,1,22) = "INDEPENDENCE PROVIDERS"
  then vendor= "INDEPENDENCE PROVIDERS INC";
  put vendor;
  if substr(vendor,1,17) = "INTERWEST MEDICAL"
  then vendor= "INTERWEST MEDICAL";
  put vendor;
RUN;
data vendorAE;

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set vendorAD;
if substr(vendor,1,8) = "INVACARE"
  then vendor= "INVACARE";
  put vendor;
if substr(vendor,1,3) = "JAY"
  then vendor= "JAY MEDICAL";
  put vendor;
if substr(vendor,1,59) = "JOE'S"
  then vendor= "JOE'S MOBILITY";
  put vendor;
  if substr(vendor,1,13) = "JOHN DAVIS CO"
    then vendor= "JOHN DAVIS CO";
    put vendor;
    if substr(vendor,1,12) = "JORDAN RESES"
      then vendor= "JORDAN RESES HOME HEALTH CARE";
      put vendor;
if substr(vendor,1,12) = "JORDAN-RESES"
  then vendor= "JORDAN RESES HOME HEALTH CARE";
  put vendor;
  RUN;
  data vendorAF;
set vendorAE;
if substr(vendor,1,20) = "LIGHTNING HANDCYCLES"
  then vendor= "LIGHTNING HANDCYCLES";
  put vendor;
if substr(vendor,1,15) = "LIGHTENING HAND"
  then vendor= "LIGHTNING HANDCYCLES";
  put vendor;
if substr(vendor,1,4) = "LEVO"
  then vendor= "LEVO USA INC";
  put vendor;
if substr(vendor,1,7) = "LEISURE"
  then vendor= "LEISURE LIFT INC";
  put vendor;
if substr(vendor,1,5) = "JOE'S"
  then vendor= "JOE'S MOBILITY";
  put vendor;
  if substr(vendor,1,5) = "LABAC"
    then vendor= "LABAC SYSTEMS INC";
    put vendor;
    if substr(vendor,1,6) = "LA BAC"
      then vendor= "LABAC SYSTEMS INC";
      put vendor;
  RUN;
  data vendoraaf ;
set vendoraf;
if substr(vendor,1,13) = "FREEDOM RYDER"
  then vendor= "FREEDOM RYDER HANDCYCLES";
if substr(vendor,1,5) = "FUQUA"
  then vendor= "FUQUA ENTERPRISES INC";
if substr(vendor,1,12) = "GRAHAM FIELD"
  then vendor= "EVEREST & JENNINGS";
if substr(vendor,1,7) = "HALL'S"
  then vendor= "HALLS WHEELS";
if substr(vendor,1,19) = "HEALTHCARE EQUIPMENT"
  then vendor= "HEALTHCARE EQUIPMENT & SUPPLIES";
if substr(vendor,1,19) = "HOME MEDICAL"

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    then vendor= "HOME MEDICAL SUPPLY";
    put vendor;
run;
data vendorAG;
set vendorAaF;
if substr(vendor,1,7) = "LINCARE"
    then vendor= "LINCARE INC";
    put vendor;
if substr(vendor,1,5) = "LUMEX"
    then vendor= "GRAHAM FIELD";
    put vendor;
if substr(vendor,1,12) = "Leisure Lift"
    then vendor= "LEISURE LIFT INC";
    put vendor;
if substr(vendor,1,20) = "Lightning Handcycles"
    then vendor= "LIGHTNING HANDCYCLES";
    put vendor;
    if substr(vendor,1,20) = "Lightning Handcycles"
        then vendor= "LIGHTNING HANDCYCLES";
        put vendor;
    RUN;
data vendorAh;
set vendorAg;
if substr(vendor,1,17) = "MEDICAL HOME CARE"
    then vendor= "MEDICAL HOME CARE INC";
    put vendor;
if substr(vendor,1,9) = "MED-EQUIP"
    then vendor= "MED-EQUIP INC";
    put vendor;
if substr(vendor,1,10) = "MAC'S LIFT"
    then vendor= "MAC'S LIFT GATE INC";
    put vendor;
    RUN;
data vendorAhh;
set vendorAh;
if substr(vendor,1,7) = "MEDBLOC"
    then vendor= "MEDBLOC INC";
    put vendor;
if substr(vendor,1,22) = "MEDICAL EQUIPMENT SPEC"
    then vendor= "MEDICAL EQUIPMENT SPECIALITY";
    put vendor;
if substr(vendor,1,6) = "HANGER"
    then vendor= "HANGER PROSTHETICS";
    put vendor;
if substr(vendor,1,18) = "MEDICAL INDUSTRIES"
    then vendor= "MEDICAL INDUSTRIES AMERICA INC";
    put vendor;
if substr(vendor,1,16) = "MEDICAL MOBILITY (8789)"
    then vendor= "MEDICAL MOBILITY";
    put vendor;
    if substr(vendor,1,13) = "MEDICAL PLACE"
        then vendor= "MEDICAL PLACE INC";
        put vendor;
if substr(vendor,1,17) = "MEDICAL-EQUIPMENT"
    then vendor= "MEDICAL-EQUIPMENT INC";
    if substr(vendor,1,9) = "MED-EQUIP"
        then vendor= "MED-EQUIP INC";

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    put vendor;
    RUN;
    data vendorAi;
set vendorAhh;
if substr(vendor,1,11) = "MEDLINE IND"
    then vendor= "MEDLINE INDUSTRIES INC";
    put vendor;
if substr(vendor,1,23) = "MEDICAL MOBILITY (8789)"
    then vendor= "MEDICAL MOBILITY";
    put vendor;
if substr(vendor,1,9) = "MEDI-SERV"
    then vendor= "MEDI SERVE HOMECARE";
    put vendor;
if substr(vendor,1,17) = "MEDICAL HOME CARE"
    then vendor= "MEDICAL HOME CARE INC";
    put vendor;
if substr(vendor,1,9) = "MED-EQUIP"
    then vendor= "MED-EQUIP INC";
    put vendor;
if substr(vendor,1,10) = "MAC'S LIFT"
    then vendor= "MAC'S LIFT GATE INC";
    put vendor;
    RUN;
data vendorBJ;
set vendorAI;
if substr(vendor,1,7) = "MEDTECH"
    then vendor= "MEDTECH SERVICE";
    put vendor;
if substr(vendor,1,10) = "MID-CITIES"
    then vendor= "MID CITIES HOME MEDICAL/ INC.";
    put vendor;
if substr(vendor,1,13) = "MIKES MEDICAL"
    then vendor= "MIKE'S MEDICAL";
    put vendor;
if substr(vendor,1,18) = "MOBILITY EQUIPMENT"
    then vendor= "MOBILITY EQUIPMENT INC";
    put vendor;
if substr(vendor,1,13) = "MOBILITY PLUS"
    then vendor= "MOBILITY PLUS INC";
    put vendor;
if substr(vendor,1,17) = "MOBILITY PRODUCTS"
    then vendor= "MOBILITY PRODUCTS CO";
    put vendor;
    RUN;
data vendorbK;
set vendorbJ;
if substr(vendor,1,7) = "MEDTECH"
    then vendor= "MEDTECH SERVICE";
    put vendor;
if substr(vendor,1,10) = "MID-CITIES"
    then vendor= "MID CITIES HOME MEDICAL/ INC.";
    put vendor;
if substr(vendor,1,13) = "MIKES MEDICAL"
    then vendor= "MIKE'S MEDICAL";
    put vendor;
if substr(vendor,1,18) = "MOBILITY EQUIPMENT"
    then vendor= "MOBILITY EQUIPMENT INC";

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    put vendor;
if substr(vendor,1,13) = "MOBILITY PLUS"
    then vendor= "MOBILITY PLUS INC";
    put vendor;
if substr(vendor,1,22) = "MOBILITY SYSTEMS & SOL"
    then vendor= "MOBILITY SYSTEMS AND SOLUTIONS/ INC";
    put vendor;
    RUN;
data vendorbL;
set vendorbK;
if substr(vendor,1,12) = "MORNING STAR"
    then vendor= "MORNING STAR MOBILITY INC";
    put vendor;
if substr(vendor,1,13) = "MOTION DESIGN"
    then vendor= "MOTION DESIGNS/ INC";
    put vendor;
if substr(vendor,1,9) = "MOVING ON"
    then vendor= "MOVIN ON MOBILITY INC";
    put vendor;
if substr(vendor,1,13) = "MOVING PEOPLE"
    then vendor= "MOVING PEOPLE.NET";
    put vendor;
if substr(vendor,1,8) = "MULLANEY"
    then vendor= "MULLANEY'S ACTIVE MOBILITY";
    put vendor;
if substr(vendor,1,16) = "Mobility Express"
    then vendor= "MOBILITY EXPRESS";
    put vendor;
    RUN;
data vendorbL;
set vendorbL;
if substr(vendor,1,16) = "MEDICAL MOBILITY"
    then vendor= "MEDICAL MOBILITY";
if substr(vendor,1,8) = "LAPLANTE"
    then vendor= "LAPLANTE MEDICAL SUPPLY";
if substr(vendor,1,9) = "LaPLANTE"
    then vendor= "LA PLANTE MEDICAL SUPPLY";
    put vendor;
    if substr(vendor,1,16) = "NATIONAL SEATING"
        then vendor= "NATIONAL SEATING & MOBILITY";
        put vendor;
if substr(vendor,1,8) = "NEW HALL"
    then vendor= "NEW HALL'S WHEELS";
    put vendor;
if substr(vendor,1,5) = "NORCO"
    then vendor= "NORCO INC";
    put vendor;
if substr(vendor,1,19) = "NORTH COAST MEDICAL"
    then vendor= "MORTH COAST MEDICAL INC";
    put vendor;
if substr(vendor,1,7) = "OPTIWAY"
    then vendor= "OPTIWAY TECHNOLOGY INC";
    put vendor;
if substr(vendor,1,14) = "ORTHO-KINETICS"
    then vendor= "ORTHO KINETICS INC";
    put vendor;
if substr(vendor,1,14) = "ORTHO KINETICS"

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    then vendor= "ORTHO KINETICS INC";
    put vendor;
    RUN;
data vendorcN;
set vendorb11;
if substr(vendor,1,8) = "PERMOBIL"
    then vendor= "PERMOBIL INC";
    put vendor;
if substr(vendor,1,7) = "COLOURS"
    then vendor= "PERMOBIL INC";
    put vendor;
if substr(vendor,1,12) = "PCP-CHAMPION"
    then vendor= "PCP CHAMPION DIV";
    put vendor;
if substr(vendor,1,12) = "PCP CHAMPION"
    then vendor= "PCP CHAMPION DIV";
    put vendor;
if substr(vendor,1,9) = "OTTO BOCK"
    then vendor= "OTTO BOCK ORTHOPEDIC";
    put vendor;
if substr(vendor,1,23) = "MORTH COAST MEDICAL INC"
    then vendor= "NORTH COAST MEDICAL INC";
    put vendor;
    if substr(vendor,1,22) = "PROGRESSIVE HEALTHCARE"
        then vendor= "PROGRESSIVE HEALTHCARE SYSTEMS";
        put vendor;
if substr(vendor,1,18) = "PROGRESSIVE HELATH"
    then vendor= "PROGRESSIVE HEALTHCARE SYSTEMS";
    put vendor;
if substr(vendor,1,5) = "PRIDE"
    then vendor= "PRIDE HEALTH CARE INC";
    put vendor;
    if substr(vendor,1,12) = "ORTHOTIC LAB"
        then vendor= "PSAS";
        put vendor;
        if substr(vendor,1,17) = "ORTHOTIC LAB/VAMC"
            then vendor= "ORTHOTIC LAB VAMC";
            put vendor;
if substr(vendor,1,14) = "PROGRESSIVE HE"
    then vendor= "PROGRESSIVE HEALTHCARE";
    put vendor;
if substr(vendor,1,6) = "PROS S"
    then vendor= "PSAS";
    put vendor;
if vendor= "PROSTHETIC ORTHOTIC SPECIALISTS" THEN DELETE;
/*need to delete this so my other programs would work
it would have been deleted in the next go-round anyway
since it only has a occurance of 1 */
if vendor= "PROSTHETICS OF LOUISVILLE" THEN
    vendor= "LOUISVILLE,PROSTHETICS OF";
if substr(vendor,1,4) = "PSAS"
    then vendor= "PSAS";
    put vendor;
if substr(vendor,1,8) = "Permobil"
    then vendor= "PERMOBIL INC";
    put vendor;
if substr(vendor,1,7) = "QUICKIE"

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    then vendor= "QUICKIE";
    put vendor;
if substr(vendor,1,10) = "RJM & ASSOC"
    then vendor= "RJM & ASSOCIATES";
    put vendor;
run;
data vendorcQ;
set vendorcn;
if substr(vendor,1,9) = "PENNYRILE"
    then vendor= "PENNEYRILE HOME MEDICAL";
if substr(vendor,1,9) = "PIEDMONT"
    then vendor= "PIEDMONT MEDICAL SUPPLY";
    put vendor;
RUN;
DATA vendorcR;
set vendorcQ;
if substr(vendor,1,10) = "RJM & ASSO"
    then vendor= "RJM & ASSOCIATES";
    put vendor;
if substr(vendor,1,8) = "RJM ASSO"
    then vendor= "RJM & ASSOCIATES";
    if substr(vendor,1,6) = "ROTECH"
        then vendor= "ROTECH MEDICAL CORPORATION";
    if substr(vendor,1,6) = "Rotech"
        then vendor= "ROTECH MEDICAL CORPORATION";
if substr(vendor,1,9) = "SAFE-LITE"
    then vendor= "SAFE LITE OPTICAL CO INC";
if substr(vendor,1,6) = "SAMMON"
    then vendor= "SAMMONS PRESTON INC";
if substr(vendor,1,6) = "SENIOR NOTES INC."
    then vendor= "SENIOR NOTES INC";
    put vendor;
if substr(vendor,1,12) = "SMITH NEPHEW"
    then vendor= "SMITH & NEPHEW";
    put vendor;
if substr(vendor,1,14) = "SMITH & NEPHEW"
    then vendor= "SMITH & NEPHEW";
    put vendor;
if substr(vendor,1,17) = "SENIOR NOTES INC."
    then vendor= "SENIOR NOTES INC";
    put vendor;
if substr(vendor,1,9) = "SAFE LITE"
    then vendor= "SAFELITE OPTICAL CO INC";
    put vendor;
if substr(vendor,1,8) = "SIEBERT"
    then vendor= "SIEBERT & ASSOCIATES INC";
    put vendor;
if substr(vendor,1,11) = "SOUTHERN IL"
    then vendor= "SOUTHERN ILLINOIS SURGICAL";
    put vendor;
if substr(vendor,1,3) = "SPD"
    then vendor= "SPD";
    put vendor;
if substr(vendor,1,9) = "STAND AID"
    then vendor= "STAND AID";
    put vendor;
if substr(vendor,1,9) = "STOCK"

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    then vendor= "PSAS";
    put vendor;
if substr(vendor,1,7) = "SUN MED"
    then vendor= "SUN MEDICAL";
    put vendor;
if substr(vendor,1,7) = "SUN MED"
    then vendor= "SUN MEDICAL";
    put vendor;
if substr(vendor,1,7) = "SUN-MED"
    then vendor= "SUN MEDICAL";
    put vendor;
if substr(vendor,1,6) = "SUNMED"
    then vendor= "SUN MEDICAL";
    put vendor;
    RUN;
DATA vendorcS;
set vendorcR;
if substr(vendor,1,10) = "PROSTHETIC"
    then vendor= "PSAS";
    put vendor;
    if substr(vendor,1,5) = "STOCK"
        then vendor= "PSAS";
        put vendor;
    RUN;
DATA vendorcT;
set vendorcS;
if substr(vendor,1,6) = "REDMAN"
    then vendor= "REDMAN POWER CHAIR LLC";
    put vendor;
    if substr(vendor,1,5) = "STOCK"
        then vendor= "PSAS";
        put vendor;
    RUN;
DATA vendorcU;
set vendorcT;
if substr(vendor,1,6) = "Redman"
    then vendor= "REDMAN POWER CHAIR LLC";
    put vendor;
    if substr(vendor,1,4) = "ROHO"
        then vendor= "ROHO";
        put vendor;
    RUN;
DATA vendorcV;
set vendorcU;
if substr(vendor,1,7) = "QUICKIE"
    then vendor= "SUNRISE MEDICAL INC";
    put vendor;
if substr(vendor,1,14) = "SUNRISEMEDICAL"
    then vendor= "SUNRISE MEDICAL INC";
    put vendor;
if substr(vendor,1,7) = "SUNRISE"
    then vendor= "SUNRISE MEDICAL INC";
    put vendor;
if substr(vendor,1,7) = "TITANIUM SPORTS"
    then vendor= "TI SPORT";
    put vendor;
if substr(vendor,1,7) = "TISport"

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    then vendor= "TI SPORT";
    put vendor;
if substr(vendor,1,7) = "TISPORT"
    then vendor= "TI SPORT";
    put vendor;
if substr(vendor,1,9) = "TI SPORTS"
    then vendor= "TI SPORT";
    put vendor;
if substr(vendor,1,9) = "THERADYNE"
    then vendor= "THERADYNE";
    put vendor;
if substr(vendor,1,8) = "THERAFIN"
    then vendor= "THERAFIN CORP";
    put vendor;
if substr(vendor,1,17) = "THE MEDICAL STORE"
    then vendor= "THE MEDICAL STORE INC";
    put vendor;
if substr(vendor,1,6) = "TEFTEC"
    then vendor= "TEFTEC CORP";
    put vendor;
if substr(vendor,1,11) = "SUN MEDICAL"
    then vendor= "SUNRISE MEDICAL INC";
    put vendor;
    RUN;
DATA vendorcW;
set vendorcV;
if substr(vendor,1,22) = "ROCKY MOUNTAIN MEDICAL"
    then vendor= "ROCKY MOUNTAIN MEDICAL";
    put vendor;
    if substr(vendor,1,15) = "SARATOGA ACCESS"
    then vendor= "SARATOGA ACCESS";
    put vendor;
    if substr(vendor,1,13) = "SCOOTER DEPOT"
    then vendor= "SCOOTER DEPOT";
    put vendor;
    if substr(vendor,1,17) = "SCOOTERS AND MORE"
    then vendor= "SCOOTERS AND MORE";
    put vendor;
if substr(vendor,1,17) = "SPORTAID"
    then vendor= "SPORTAID";
    put vendor;
if substr(vendor,1,9) = "SNUG SEAT"
    then vendor= "SNUG SEAT";
    put vendor;
if substr(vendor,1,9) = "STANDING CO"
    then vendor= "STANDING COMPANY";
    put vendor;
if substr(vendor,1,8) = "SPORTAID"
    then vendor= "SPORTAID";
    put vendor;
if substr(vendor,1,3) = "V A"
    then vendor= "PSAS";
    put vendor;
if substr(vendor,1,11) = "U S DEPT OF"
    then vendor= "PSAS";
    put vendor;
if substr(vendor,1,11) = "U S DEPT OF"

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    then vendor= "PSAS";
    put vendor;
if substr(vendor,1,15) = "TITANIUM SPORTS"
    then vendor= "TI SPORT";
    put vendor;
if substr(vendor,1,7) = "TiSport"
    then vendor= "TI SPORT";
    put vendor;
if substr(vendor,1,7) = "TOP END"
    then vendor= "TOP END INC";
    put vendor;
if substr(vendor,1,18) = "UNITED MEDICAL/INC"
    then vendor= "UNITED MEDICAL EQUIPMENT CO INC";
    put vendor;
RUN;
DATA vendorcx;
set vendorcw;
if substr(vendor,1,7) = "VA 1210"
    then vendor= "PSAS";
    put vendor;
if substr(vendor,1,6) = "VA ADM"
    then vendor= "PSAS";
    put vendor;
if substr(vendor,1,6) = "VA MED"
    then vendor= "PSAS";
    put vendor;
if substr(vendor,1,6) = "VA Med"
    then vendor= "PSAS";
    put vendor;
if substr(vendor,1,6) = "VA NAT"
    then vendor= "PSAS";
    put vendor;
if substr(vendor,1,6) = "VA Nat"
    then vendor= "PSAS";
    put vendor;
if substr(vendor,1,6) = "VA Nat"
    then vendor= "PSAS";
    put vendor;
if substr(vendor,1,6) = "VA Nat"
    then vendor= "PSAS";
    put vendor;
if substr(vendor,1,8) = "VA DEPOT"
    then vendor= "PSAS";
    put vendor;
if substr(vendor,1,9) = "VA HEALTH"
    then vendor= "PSAS";
    put vendor;
if substr(vendor,1,6) = "VA ORT"
    then vendor= "PSAS";
    put vendor;
if substr(vendor,1,6) = "VA PRO"
    then vendor= "PSAS";
    put vendor;
if substr(vendor,1,7) = "VA STOT"
    then vendor= "PSAS";
    put vendor;
if substr(vendor,1,6) = "VA SUP"

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    then vendor= "PSAS";
    put vendor;
if substr(vendor,1,6) = "VA WAR"
    then vendor= "PSAS";
    put vendor;
if substr(vendor,1,6) = "VA WES"
    then vendor= "PSAS";
    put vendor;
if substr(vendor,1,5) = "VA-PR"
    then vendor= "PSAS";
    put vendor;
if substr(vendor,1,6) = "VA/STO"
    then vendor= "PSAS";
    put vendor;
if substr(vendor,1,7) = "VACIHCS"
    then vendor= "PSAS";
    put vendor;
if substr(vendor,1,5) = "VA ST"
    then vendor= "PSAS";
    put vendor;
if substr(vendor,1,5) = "VAMC"
    then vendor= "PSAS";
    put vendor;
if substr(vendor,1,11) = "WESTERN MED"
    then vendor= "WESTERN MEDICAL INC";
    put vendor;
if substr(vendor,1,9) = "WAREHOUSE"
    then vendor= "PSAS";
    put vendor;
if substr(vendor,1,8) = "WALGREEN"
    then vendor= "WALGREENS";
    put vendor;
if substr(vendor,1,7) = "VISN"
    then vendor= "PSAS";
    put vendor;
if substr(vendor,1,7) = "VETERAN"
    then vendor= "PSAS";
    put vendor;
if substr(vendor,1,4) = "VAMC"
    then vendor= "PSAS";
    put vendor;
if substr(vendor,1,11) = "WHEEL-CARE"
    then vendor= "WHEELCARE INC";
    put vendor;
if substr(vendor,1,11) = "WHEELCARE"
    then vendor= "WHEELCARE INC";
    put vendor;
if substr(vendor,1,4) = "VISN"
    then vendor= "PSAS";
    put vendor;
if substr(vendor,1,16) = "mobility systems"
    then vendor= "MOBILITY SYSTEMS INC";
    put vendor;
if substr(vendor,1,14) = "Wright Medical"
    then vendor= "WRIGHT MEDICAL INC";
    put vendor;
if substr(vendor,1,20) = "WHEELCHAIR INSTITUTE"

```

```

    then vendor= "WHEELCHAIR INSTITUTE OF KANSAS";
    put vendor;
if substr(vendor,1,21) = "WHEELCHAIRS OF KANSAS"
    then vendor= "WHEELCHAIR INSTITUTE OF KANSAS";
    put vendor;
if substr(vendor,1,20) = "WHEELCHAIR OF KANSAS"
    then vendor= "WHEELCHAIR INSTITUTE OF KANSAS";
    put vendor;
if substr(vendor,1,28) = "WHEELCHAIR & SCOOTER EXPRESS"
    then vendor= "WHEELCHAIR AND SCOOTER EXPRESS";
    put vendor;
if substr(vendor,1,17) = "WHEELCHAIR CENTER"
    then vendor= "WHEELCHAIR CENTER INC";
    put vendor;
if substr(vendor,1,4) = "VISN"
    then vendor= "PSAS";
    put vendor;
    RUN;
DATA vendorcY;
set vendorcx;
if substr(vendor,1,7) = "VA 1210"
    then vendor= "PSAS";
    put vendor;
if substr(vendor,1,6) = "VA ADM"
    then vendor= "PSAS";
    put vendor;
if substr(vendor,1,6) = "VA MED"
    then vendor= "PSAS";
    put vendor;
if substr(vendor,1,10) = "VA MEDICAL"
    then vendor= "PSAS";
    put vendor;
if substr(vendor,1,6) = "VA NAT"
    then vendor= "PSAS";
    put vendor;
if substr(vendor,1,6) = "VA Nat"
    then vendor= "PSAS";
    put vendor;
if substr(vendor,1,8) = "VA DEPOT"
    then vendor= "PSAS";
    put vendor;
if substr(vendor,1,9) = "VA HEALTH"
    then vendor= "PSAS";
    put vendor;
if substr(vendor,1,6) = "VA ORT"
    then vendor= "PSAS";
    put vendor;
if substr(vendor,1,7) = "VA PROS"
    then vendor= "PSAS";
    put vendor;
if substr(vendor,1,8) = "VA STOCK"
    then vendor= "PSAS";
    put vendor;
if substr(vendor,1,6) = "VA SUP"
    then vendor= "PSAS";
    put vendor;
if substr(vendor,1,6) = "VA WAR"

```

```

    then vendor= "PSAS";
    put vendor;
if substr(vendor,1,5) = "VA-PR"
    then vendor= "PSAS";
    put vendor;
if substr(vendor,1,4) = "VAMC"
    then vendor= "PSAS";
    put vendor;
    RUN;
DATA vendorcZ;
set vendorcY;
if substr(vendor,1,8) = "VETERANS"
    then vendor= "PSAS";
    put vendor;
if substr(vendor,1,8) = "VA/STOCK"
    then vendor= "PSAS";
    put vendor;
if substr(vendor,1,9) = "WAREHOUSE"
    then vendor= "PSAS";
    put vendor;
if substr(vendor,1,8) = "WALGREEN"
    then vendor= "WALGREENS";
    put vendor;
if substr(vendor,1,15) = "WESTERN MEDICAL"
    then vendor= "WESTERN MEDICAL INC";
if substr(vendor,1,9) = "WHEELCARE"
    then vendor= "WHEELCARE INC";
    put vendor;
if substr(vendor,1,22) = "WHEELCHAIR AND SCOOTER"
    then vendor= "WHEELCHAIR & SCOOTER EXPRESS";
    put vendor;
if substr(vendor,1,17) = "WHEELCHAIR CENTER"
    then vendor= "WHEELCHAIR CENTER INC";
    put vendor;
if substr(vendor,1,21) = "WHEELCHAIRS OF KANSAS"
    then vendor= "WHEELCHAIRS OF KANSAS";
    put vendor;
if substr(vendor,1,20) = "WHEELCHAIR OF KANSAS"
    then vendor= "WHEELCHAIRS OF KANSAS";
    put vendor;
if substr(vendor,1,20) = "WHEELCHAIR INSTITUTE"
    then vendor= "WHEELCHAIR INSTITUTE OF KANSAS";
    put vendor;
if substr(vendor,1,14) = "Wright Medical"
    then vendor= "WRIGHT MEDICAL INC";
    put vendor;
if substr(vendor,1,16) = "mobility systems"
    then vendor= "MOBILITY SYSTEMS";
    put vendor;
    RUN;
DATA vendorcZZ;
set vendorcz;
if substr(vendor,1,11) = "STANDING CO"
    then vendor= "STANDING COMPANY";
    put vendor;
    RUN;
proc sort data=vendorczz;

```

```

    by vendor;
    run;
data KACHOO; /*1325 to 696 vendors*/
set VENDORcZZ;
by vendor;
if FIRST.VENDOR=1 THEN OUTPUT;
run;
data kazoo; /*1325 to 696 vendors*/
set cutoff2;
by vendor;
if FIRST.VENDOR=1 THEN OUTPUT;
run;
data disser.vendor_clean_reviz; /*unique clean vendors*/
set vendorczz;
run;
data vendorczz;
set disser.vendor_clean_reviz;
run;
/*Now I have to delete vendors with less than 4 total sales*/
/*ods trace on/label listing;
proc freq data=vendoredita;
    tables vendor;
run;
ods trace off;*/
ods output onewayfreqs=freq; /*Jill's program*/
proc freq data=vendorczz;
    tables vendor; /*all records with vendor names edited*/
run;
data vendor_morethan5 (keep=vendor);
    set freq; /*get rid of vendors with LE 4 sales*/
    if frequency LE 4 then delete;
run;
proc sort data=vendorczz; by vendor;run;
proc sort data=vendor_morethan5 ; by vendor;run;
data cut29;
    merge vendorczz vendor_morethan5 (in=five);
    by vendor;
    if five;
run; /*all records of vendors who have 5 or more sales*/
proc freq data=vendor5_or_more; /*test to see if all <5 are gone*/
tables vendor;
run; /*yup all gone - left 113336 obs <5 sales got rid of 766 records*/
data disser.vendor5_or_more_reviz;
set vendor5_or_more;
run;
data kazoo; /*this is a check to see how many vendors in >5 group*/
set vendor5_or_more;
by vendor;
if FIRST.VENDOR=1 THEN OUTPUT;
run; /*only 243 vendors left*/
/*delete vendors whose total cost is less than $800*/
data vendor5;
set disser.vendor5_or_more_reviz;
run;
/*firt I need to calculate a total cost*/
data vendor_totalcost;
set vendor5;

```

```

by vendor;
retain vendor cost freq;
if first.vendor then do;
vendorcost=0;
end;
vendorcost + cost;
freq + 1;
if last.vendor then output vendor_totalcost;
run; /* good I have the total cost for each of the 243 vendors
save as word file: "topvendors"*/
proc sort data=vendor_totalcost;
by vendorcost;
run;
proc print data=vendor_totalcost width=minimum;
var vendor vendorcost;
run;
data disser.vendor_totalcost;
set vendor_totalcost;
run;
data vendor_100; /*these are my top 100 vendors for the analysis*/
set vendor_totalcost;
grabem=0;
if vendorcost GT 55000 then grabem=1;
if grabem=1 then output vendor_100;
run;
PROC SORT DATA=H5dataset2 ;
by vendorcost;
RUN;
data H5dataset2; /*YESS!!! all records of top 100 vendors verified
!!*/
merge vendor5 (in=five) vendor_100 (in=onehundred) ;
by vendor;
if onehundred;
run;
data disser.H5vendor;
set H5dataset2;
run;
/*now need top 20 HCPCS in volume*/
proc sort data=H5dataset2;
by HCPCSPSAS;
run;
proc freq data= H5dataset2;
tables HCPCSPSAS;
run; /*this is all hcpcs
I need to sort them to get top 20
need a frequency variable*/
ods output onewayfreqs=hcpfreq;
proc freq data=H5dataset2;
tables HCPCSPSAS;
run;
proc sort data=hcpfreq; by frequency; run;
/*Perfect ! got hcpcspas sorted by frequency*/
proc print data=hcpfreq width=minimum;
var frequency HCPCSPSAS ;
run;
data final3;
set hcpfreq; /*here are my 20 most frequent HCPCSPSAS*/

```

```

if frequency GT 700 then output final3;
run;
data disser.top20hcpcspas;
set final3;
run;
proc print data=final3;
var hcpcspas frequency percent;
run;
/*now merge these back into dataset of all records top 100 vendor*/
proc sort data=final3; by HCPCSPAS;run;
data H5data; /*YESS!!! all records of top 100 vendors verified !!*/
merge H5dataset2 (in=ven) final3 (in=hcp) ;
by hcpcspas;
if hcp;
run;
data disser.H5data;
set H5data;
run;

/*delete vendors who have less than $800 in sales
Did not need to do this
got them all with LT 5
data lessthan800; weren't any-got them all with LT 5 records
set vendor_totalcost;
if vendorcost LT 800.00 then delete;
run; */

/*difference between making adj and not
USE SUM FUNCTION sas ii PAGE 3-9*/
data no (keep= vendor cost);
set disser.chair_cost00;
run;
data nono;
set no nol;
run;
data money; /*$109,010,198.00 total for 00+01*/
set nono;
tcost+cost;
run;
data money2; /*$50,097,805.00 total for 00*/
set no;
tcost+cost;
run;
data money3; /*$58,912,393.00 total for 01*/
set nol;
tcost+cost;
run;
proc print data=money3;
run;
/*now repeat for un-adjsted data*/
data gol (keep= vendor cost);
set disser.nppd01_chair_reviz;
run;
data gogo;
set go gol;
run;

```

```
data money4; /*$104,524,242.00 total for 00+01*/
set gogo;
tcost+cost;
run;
data money5; /*$48,097,022.00 total for 00*/
set go;
tcost+cost;
run;
data money6; /*$56,427,220.00 total for 01*/
set gol;
tcost+cost;
run;
proc print data=money6;
run;
```

APPENDIX E

SAS Code Chapter 3 Cost Study Hypothesis 1 Analyses

```

-../*this is the program I wrote after my defense
first need to clean data
combine 00 and 01*/
data chair_cost003 (rename=(hcpcpsas=hcpcpsas));
set disser.chair_cost00;
year=1;
run; /*63351 obs*/
data chair_cost01; /*67861 obs*/
set disser.chair_cost01;
year=2;
run;
data chair_cost_both2; /*131212*/
set chair_cost003 chair_cost01;
run;
data chair_cost_both (keep=VISN hcpcpsas cost vendor); /*131212*/
set chair_cost_both2;
run;
/*now need to determine cut-off points*/
data disser.chair_cost_both;
set chair_cost_both;
run;
data chair_cost_no_zero2; /*delete missing values*/
set chair_cost_both;
/*if cost = '' then delete;*/
if cost = '.' then delete;
run;
data chair_cost_no_zero5; /*delete 0.00 values*/
set chair_cost_no_zero2;
if cost = 0.00 then delete;
run;
/*how many hcpcs do I have?*/
proc freq data=chair_cost_no_zero5;
  tables hcpcpsas;
  run;
/*delete hcpcs codes with less than 20 obs*/
data chair_cost_hcp4;
set chair_cost_no_zero5;
if hcpcpsas= 'E1085' then delete;
if hcpcpsas= 'E1091' then delete;
if hcpcpsas= 'E1170' then delete;
if hcpcpsas= 'E1299' then delete;
run; /*121762 obs remaining*/
data disser.chair_cost;
set chair_cost_hcp4;
run;
data chair_cost_hcp;
set chair_cost_hcp4;
if hcpcpsas= 'E1065' then delete;

```

```

run; /*121601 obs remaining*/
ods output onewayfreqs=freq;
proc freq data=chair_cost_hcp;
tables hcpcspas;
run;
/* run for all 64 HCPCS codes*/
proc freq data=chair_cost_hcp;
tables cost;
where hcpcspas= "K0013";
run;
data disser.chair_cost_hcp;
set chair_cost_hcp;
run;
data chair_cost_hcp; /*121601*/
set disser.chair_cost_hcp;
run;
/*next I have to drop obs below cut-off point out of dataset*/
data cut1; /*121591 - 10 excluded*/
set chair_cost_hcp;
if hcpcspas="E1050" and cost LT 100 then delete;
run;
/*make sure this is correct*/
proc sort data=chair_cost_hcp;
by hcpcspas cost;
run; /*program works correctly*/
data cut; /*113724*/
set disser.chair_cost_hcp;
if hcpcspas="E1050" and cost LT 100 then delete;
if hcpcspas="E1060" and cost LT 100 then delete;
if hcpcspas="E1070" and cost LT 100 then delete;
if hcpcspas="E1083" and cost LT 100 then delete;
if hcpcspas="E1084" and cost LT 100 then delete;
if hcpcspas="E1086" and cost LT 100 then delete;
if hcpcspas="E1092" and cost LT 100 then delete;
if hcpcspas="E1093" and cost LT 100 then delete;
if hcpcspas="E1100" and cost LT 100 then delete;
if hcpcspas="E1110" and cost LT 100 then delete;
if hcpcspas="E1130" and cost LT 100 then delete;
if hcpcspas="E1140" and cost LT 100 then delete;
if hcpcspas="E1150" and cost LT 100 then delete;
if hcpcspas="E1160" and cost LT 100 then delete;
if hcpcspas="E1171" and cost LT 100 then delete;
if hcpcspas="E1172" and cost LT 100 then delete;
if hcpcspas="E1180" and cost LT 100 then delete;
if hcpcspas="E1190" and cost LT 100 then delete;
if hcpcspas="E1195" and cost LT 100 then delete;
if hcpcspas="E1200" and cost LT 100 then delete;
if hcpcspas="E1220" and cost LT 100 then delete;
if hcpcspas="E1221" and cost LT 100 then delete;
if hcpcspas="E1222" and cost LT 100 then delete;
if hcpcspas="E1223" and cost LT 100 then delete;
if hcpcspas="E1224" and cost LT 100 then delete;
if hcpcspas="E1125" and cost LT 100 then delete;
if hcpcspas="E1126" and cost LT 100 then delete;
if hcpcspas="E1127" and cost LT 100 then delete;
if hcpcspas="E1128" and cost LT 100 then delete;
if hcpcspas="E1280" and cost LT 100 then delete;

```

```

if hcpcspas="E1285" and cost LT 100 then delete;
if hcpcspas="E1290" and cost LT 100 then delete;
if hcpcspas="E1295" and cost LT 100 then delete;
if hcpcspas="E1296" and cost LT 100 then delete;
if hcpcspas="E1297" and cost LT 100 then delete;
if hcpcspas="E1298" and cost LT 100 then delete;
if hcpcspas="K0001" and cost LT 100 then delete;
if hcpcspas="K0002" and cost LT 100 then delete;
if hcpcspas="K0003" and cost LT 100 then delete;
if hcpcspas="K0006" and cost LT 100 then delete;
if hcpcspas="K0007" and cost LT 100 then delete;
if hcpcspas="K0009" and cost LT 100 then delete;
if hcpcspas="E1087" and cost LT 200 then delete;
if hcpcspas="E1088" and cost LT 200 then delete;
if hcpcspas="E1089" and cost LT 200 then delete;
if hcpcspas="E1090" and cost LT 200 then delete;
if hcpcspas="E1240" and cost LT 200 then delete;
if hcpcspas="E1250" and cost LT 200 then delete;
if hcpcspas="E1260" and cost LT 100 then delete;
if hcpcspas="E1270" and cost LT 200 then delete;
if hcpcspas="K0004" and cost LT 200 then delete;
if hcpcspas="K0008" and cost LT 200 then delete;
if hcpcspas="K0005" and cost LT 400 then delete;
if hcpcspas="E1230" and cost LT 900 then delete;
if hcpcspas="E1210" and cost LT 1000 then delete;
if hcpcspas="E1211" and cost LT 1000 then delete;
if hcpcspas="E1212" and cost LT 1000 then delete;
if hcpcspas="E1213" and cost LT 1000 then delete;
if hcpcspas="K0010" and cost LT 1000 then delete;
if hcpcspas="K0011" and cost LT 1000 then delete;
if hcpcspas="K0012" and cost LT 1000 then delete;
if hcpcspas="K0013" and cost LT 1000 then delete;
if hcpcspas="K0014" and cost LT 1000 then delete;
run;
data disser.cutoff2;
set cut;
run;
data cutoff2;
set disser.cutoff2;
run;
/*is this distribution normal?
no data is very skewed even if analyzed by hcpcspas
use median*/
proc univariate data = cut2;
where hcpcspas="E1050";
var cost;
histogram cost / normal;
run;
/*Kruskall Wallis test between VISN
one for each hcscscode*/
proc nparlway wilcoxon data=cut2;
class VISN;
by hcpcspas;
var cost;
run;
proc univariate data = cutoff;
class hcpcspas;

```

```

by VISN;
var cost;
/*histogram cost / normal;*/
run;
proc sort data=cutoff2;
by VISN;
run;
proc freq data=cutoff;
tables hcpcspas;
by VISN;
run;
/*now I need the national median plus 10% and the national median plus
25%*/
data med_nat;
set disser.cutoff2;
costplus10=cost*1.1; /*create new var*/
costplus25=cost*1.25;
run;
/*This gives me the medians of the cost of each wc
I need medians*/
proc means data=med_nat n median nonobs maxdec=0;
var cost;
class HCPCSPAS;
output out=disser.med_national n(cost)=ncost median(cost)=mediancost
median(costplus10)=cut10 median(costplus25)=cut25; /*excel file
national.xls*/
run;
data med_nat;
set disser.med_nat;
RUN;
proc means data=med_nat n median nonobs maxdec=0;
var cost;
class HCPCSPAS;
where visn=22;
output out=med_v_22 n(cost)=ncost median(cost)=mediancost;
run;
/*7/27/2004 now need a total over amount per vins and per vendor */
data disser.cutoff2 (drop = costplus10 costplus25);
set disser.MED_NAT;
run;
data cut;
set disser.cutoff2;
run;
data cut2;
set cut;
medcut=0;
run;
data cut26;
set cut5;
if HCPCSPAS = "E1050" then medcut=783;
if HCPCSPAS = "E1060" then medcut=739;
if HCPCSPAS = "E1070" then medcut=356;
if HCPCSPAS = "E1083" then medcut=828;
if HCPCSPAS = "E1084" then medcut=872;
if HCPCSPAS = "E1086" then medcut=775;
if HCPCSPAS = "E1087" then medcut=888;
if HCPCSPAS = "E1088" then medcut=910;

```

```
if HCPCSPSAS = "E1089" then medcut=1175;
if HCPCSPSAS = "E1090" then medcut=1139;
if HCPCSPSAS = "E1092" then medcut=765;
if HCPCSPSAS = "E1093" then medcut=752;
if HCPCSPSAS = "E1100" then medcut=1281;
if HCPCSPSAS = "E1110" then medcut=1419;
if HCPCSPSAS = "E1130" then medcut=311;
if HCPCSPSAS = "E1140" then medcut=340;
if HCPCSPSAS = "E1150" then medcut=422;
if HCPCSPSAS = "E1160" then medcut=332;
if HCPCSPSAS = "E1171" then medcut=911;
if HCPCSPSAS = "E1172" then medcut=703;
if HCPCSPSAS = "E1180" then medcut=758;
if HCPCSPSAS = "E1190" then medcut=475;
if HCPCSPSAS = "E1195" then medcut=1253;
if HCPCSPSAS = "E1200" then medcut=291;
if HCPCSPSAS = "E1210" then medcut=7917;
if HCPCSPSAS = "E1211" then medcut=7608;
if HCPCSPSAS = "E1212" then medcut=8400;
if HCPCSPSAS = "E1213" then medcut=7197;
if HCPCSPSAS = "E1220" then medcut=2252;
if HCPCSPSAS = "E1220" then medcut=2252;
if HCPCSPSAS = "E1221" then medcut=1391;
if HCPCSPSAS = "E1222" then medcut=1518;
if HCPCSPSAS = "E1223" then medcut=363;
if HCPCSPSAS = "E1224" then medcut=811;
if HCPCSPSAS = "E1225" then medcut=2146;
if HCPCSPSAS = "E1226" then medcut=994;
if HCPCSPSAS = "E1227" then medcut=1890;
if HCPCSPSAS = "E1228" then medcut=698;
if HCPCSPSAS = "E1230" then medcut=3870;
if HCPCSPSAS = "E1240" then medcut=823;
if HCPCSPSAS = "E1250" then medcut=903;
if HCPCSPSAS = "E1260" then medcut=488;
if HCPCSPSAS = "E1270" then medcut=953;
if HCPCSPSAS = "E1280" then medcut=1192;
if HCPCSPSAS = "E1285" then medcut=1264;
if HCPCSPSAS = "E1290" then medcut=1146;
if HCPCSPSAS = "E1295" then medcut=1245;
if HCPCSPSAS = "E1296" then medcut=842;
if HCPCSPSAS = "E1297" then medcut=894;
if HCPCSPSAS = "E1298" then medcut=1624;
if HCPCSPSAS = "K0001" then medcut=327;
if HCPCSPSAS = "K0002" then medcut=718;
if HCPCSPSAS = "K0003" then medcut=713;
if HCPCSPSAS = "K0004" then medcut=723;
if HCPCSPSAS = "K0005" then medcut=2133;
if HCPCSPSAS = "K0006" then medcut=900;
if HCPCSPSAS = "K0007" then medcut=992;
if HCPCSPSAS = "K0008" then medcut=1835;
if HCPCSPSAS = "K0009" then medcut=1323;
if HCPCSPSAS = "K0010" then medcut=5864;
if HCPCSPSAS = "K0011" then medcut=7793;
if HCPCSPSAS = "K0012" then medcut=3987;
if HCPCSPSAS = "K0013" then medcut=9262;
if HCPCSPSAS = "K0014" then medcut=9008;
run;
```

```
data cut27;
set cut26;
dollarexceed=cost-medcut;
run;
data cut28;
set cut27;
if dollarexceed GT 0 then output;
run;
data disser.dollarexceed;
set cut28;
run;
proc means data=cut28  sum n ;
var dollarexceed;
class visn;
output OUT=dollarexceed_visn2  N=n sum=sumover;
run;
```

APPENDIX F

SAS Code Chapter 3 Cost Study Hypothesis 2 Analyses

```
/*post dissertation analysis for vendor
use cleaned dataset from H4 - rid o, missing and low values
then cleaned vendor names, 3 sales, and took too 100 vendors and top 20
hecpcs codes
then */
data cutoff2;
set disser.cutoff2;
/*if vendor="DENVER DISTRIBUTION CENTER" then output;*/
run;
data H5data;
set disser.h5data;
run;
/*need to find median values for each of the 100 vendors
top 100 vendors are in H5vendor*/
data H5vendor; /*110962 records*/
set disser.H5vendor;
run;
/*need a list of vendors for my excel spreadsheet*/
proc sort data=h5vendor;
by vendor;
run;
data h5vendor_single;
set h5vendor;
if first.vendor then output h5vendor_single;
by vendor;
run; /*export this to excel to get vendor names*/
/*get median for each of these vendors*/
data H5data;
set disser.H5data;
run;
proc means data=H5data n median maxdec=0;
var cost;
class vendor;
where HCPCSPSAS="K0012";
output out=vendor_median_k0012 n(cost)=ncost median(cost)=mediancost;
run;
data hoveround; /*5 obs*/
set cutoff2;
if vendor="HOVEROUND CORP" then output;
run;
/*now determine dollar amount over the cutoff by vendor
7/28/2004
Use dataset from h4 with same cutoffs
disser.dollarexceed (cut28)*/
proc means data=cut29 sum n ;
var dollarexceed;
class vendor;
output OUT=dollarexceed_vendor2 N=n sum=sumover;
```

```
run;
proc means data=disser.chair_cost_both sum n ; /*total dollars spent*/
var cost;
output OUT=cost N=n sum=sumover;
run;
data disser.chair_cost_both;
set disser.chair_cost00 disser.chair_cost01;
run;
proc means data=cut29 sum n ;
var dollarexceed;
class vendor;
by hcpcspas;
output OUT=wally N=n sum=sumover;
run;
PROC FREQ DATA=CUT29;
tables hcpcspas;
where vendor ="INVACARE";
run;
```

APPENDIX G

SAS Code Chapter 4 HRQoL Study Hypothesis 1 Analyses

```
/*SF-36V analysis, Hypothesis 1*/
/*need SF numco
rebuild dataset-*/
data nppdsf;
set disser.nppd_sf_all;
run;
data pecos;
set nppdsf; /*delete scooters*/
if wctype = 8 then delete;
else if wctype = 0 then delete;
run;
data pecos2;
set pecos;
if creatdate GT deldate then delete;
run;
data pecos3;
set pecos2;
if type = "INITIAL ISSUE" then output;
run;
data pecos4;
set pecos3;
numco_sf=sum(of anemia--stroke);
run;
data pecos5 (drop = austin_ssn anemia cancer oa
cataract hepatitis copd
chf dm divertis eprostat gallblad
gout
hattack hip hbp angina bowelds
irrheart
lbp otherart ulcer pvd rheumato
seizures
skcancer tia thyroid uti
prostata
stroke);
set pecos4;
run;
data pecos6;
set pecos5;
if DATES - 90 lt deldate then delete;
/*have wc for 90 days then take SF36*/
run;
data pecos7;
set pecos6;
group=0;
run;
data pecos8;
set pecos7;
if wctype=3 then group=1; /*THIS IS GROUP 1MA-ultralight*/
else if wctype=1 then group=2; /*THIS IS GROUP 1MN-depot*/
else if wctype=7 then group=3; /*THIS IS GROUP 2PA-cuspow*/
else if wctype=5 then group=4; /*THIS IS GROUP 2PN-stdpow*/
else group=0;
```

```

run;
data disser.h7;
set pecos8;
run;
data pecos8 ;
set disser.h7 ;
run;
/*start analyses
look at correlation of DV*/
proc corr data=pecos8;
var rp re sf;
run;
/* Is sample distribution normal*/
proc univariate data=pecos8;
var sf;
run;
/*Univariate Analyses*/
data manual;
set pecos8;
if group=1 then output;
else if group=2 then output;
run;
data power;
set pecos8;
if group=3 then output;
else if group=4 then output;
run;
proc freq data=power ;
tables group*dxp/chisq ;
run; /*not enough resources to run an exact test*/
proc ttest data=power;
class group;
var rp re sf numco_sf dxp ;
run;
/*now tests*/
proc glm data=power;
class group;
model re sf = group ;
run;
/*let's run the difference between manual and power for RE and SF*/
data pecos9;
set pecos8;
if wctype=3 then manu=1;
if wctype=1 then manu=1;
if wctype=7 then manu=0;
if wctype=5 then manu=0;
run;
proc ttest data=pecos9;
class manu;
var re sf;
run;
proc nparlway data=power wilcoxon median;
class group;
var rp re;
run;
/*now run for progressive only*/
data progressivepow;

```

```

set power;
if dxp=2 then output;
else if dxp=9 then output;
else if dxp=10 then output;
run;
proc freq data=progressiveman ;
tables group*dxp;
run;
proc glm data=progressiveman;
class group;
model rp re sf = group dxp numco;
title"manual";
run;quit;
proc npar1way data=progressivepow wilcoxon median;
class group;
var rp re;
run;
proc freq data=progressiveman ;
tables group*dxp;
run; /*not enough resources to run an exact test*/
proc ttest data=progressiveman;
class group;
var rp re sf numco numco_sf;
title "";
run;

```

APPENDIX H

SAS Code Chapter 4 HRQoL Study Hypothesis 2 Analyses

```
/*analysis for Hypothesis 2 or 8 in proposal*/
data irina;
set disser.nppd_sf_all;
run;
data irinal;
set irina;
if wctype = 1 then output;
else if wctype=3 then output;
else if wctype = 5 then output;
else if wctype= 7 then output;
run;
data irina2;
set irinal;
if deldate EQ DATES then delete;
run;
data disser.SF_WC  disser.WC_SF  QUE;
set irina2;
if deldate GT DATES then output disser.sf_wc;
if DATES GT deldate then output disser.wc_sf;
else output que;
run;
data wally;
set disser.SF_WC;
if creatdate GT deldate then delete;
run;
data wally1;
set wally;
numco_sf=sum(of anemia--stroke);
run;
data wally2 (drop = austin_ssn anemia      cancer      oa
cataract      heptatis      copd
              chf          dm          divertis  eprostat      gallblad
gout
              hattack      hip          hbp          angina        bowelds
irrheart
              lbp          otherart  ulcer        pvd          rheumato
seizures
              skcancer    tia          thyroid    uti          prostats
stroke);
set wally1;
run;
data wally3;
set wally2;
if wctype=3 then group=1; /*THIS IS GROUP 1-ultralight*/
else if wctype=1 then group=2; /*THIS IS GROUP 2-depot*/
else if wctype=7 then group=3; /*THIS IS GROUP 3-cuspow*/
else if wctype=5 then group=4; /*THIS IS GROUP 4-stdpow*/
else group=0;
run;
proc freq data=wally3;
```

```

tables group;
run;
data disser.h8;
set wally3; /*use this data set to add age in*/
run;
data wally3;
set disser.h8;
run;
data manual;
set irina5;
if group=1 then output;
else if group=2 then output;
run;
data power;
set irina5;
if group=3 then output;
else if group=4 then output;
run;
/*univariate analyses*/
proc ttest data=power;
class group;
var pf rp bp gh mh re sf vt pcs mcs numco_sf ;
run;
proc freq data=power ;
tables group*dxp/chisq ;
run;
proc corr data=manual;
var pf rp bp gh mh re sf vt pcs mcs;
run;
proc corr data=power;
var pf rp bp gh mh re sf vt pcs mcs;
run;
/*missing age in this dataset*/
data age (keep= patientid bd);
set disser.demodoggie;
run;
proc sort data=age;
by patientid;
run;
proc sort data=wally3;
by patientid;
run;
data wally4;
merge age (in=candles) wally3 (in=chairs);
by patientid;
if chairs;
run;
data wally5;
set wally4;
age2=deldate-bd;
run;
data manual;
set wally6;
if group=1 then output;
else if group=2 then output;
run;
data power;

```

```

set wally6;
if group=3 then output;
else if group=4 then output;
run;
/*age2 and dummy for service category is in is in now*/
data disser.manual;
set manual;
run;
data disser.power;
set power;
run;
proc ttest data=power;
class group;
var age2 ;
run;
proc freq data=manual;
tables group*category/chisq expected cellchi2;
/*exact pchi ;*/
run; /*not enough res0urces to run an exact test*/
proc freq data=power;
tables group*dxp/chisq expected cellchi2;
/*exact pchi ;*/
run;
/*now run test for H2-Logistic
control for year*/
data wally6;
set wally5;
if category="NSC/IP" then cat=1;
else if category="NSC/OP" then cat=2;
else if category="SC/IP" then cat=3;
else if category="SC/OP" then cat=4;
run; /*see Kazis_revize.sas for dummy coding*/
data manual2; /*dummy code*/
set manual;
if dxp=1 then als=1; else als=0;
if dxp=2 then ms=1; else ms=0;
if dxp=3 then scit=1; else scit=0;
if dxp=4 then scip=1; else scip=0;
if dxp=5 then stroke=1; else stroke=0;
if dxp=7 then pd=1; else pd=0;
if dxp=8 then ampu=1; else ampu=0;
if dxp=9 then copd=1; else copd=0;
if dxp=10 then arthri=1; else arthri=0;
if dxp=6 then otherdx=0; /*add TBI to other*/
if dxp=11 then otherdx=0; /*reference*/
if prioadj1=1 then pgl=1; else pgl=0;
if prioadj1=2 then pg2=1; else pg2=0;
if prioadj1=3 then pg3=1; else pg3=0;
if prioadj1=4 then pg4=1; else pg4=0;
if prioadj1=5 then pg5=1; else pg5=0;
if prioadj1=6 then pg6=1; else pg6=0;
if prioadj1=7 then pg7=1; else pg7=0;
if cat=1 then cat1=1; else cat1=0;
if cat=2 then cat2=1; else cat2=0;
if cat=3 then cat3=1; else cat3=0;
if cat=4 then cat4=1; else cat4=0;
run;

```

```

data manual3;
set manual2;
if race=1 then white=1; else white=0;
if race=2 then black=1; else black=0;
if race=3 then hisp=1; else hisp=0;
if race=4 then indian=1; else indian=0;
if race=6 then haw=1; else haw=0;
if race=6 then as=1; else as=0;
run;
/*Model 3 adj*/proc logistic data=manual3 descending;
  model group = als ms scit scip stroke pd ampu copd arthri pgl pg2
pg3 pg4 pg5 pg6
  cat1 cat2 cat3 numco_sf age2 male black hisp indian haw as year pcs
mcs/RL lackfit RSQ ;
  units age2=10 pcs=10 mcs=10/default=1;
  run;quit;
/*proc logistic data=manual3 descending;
  class prioadjl(param=ref ref='7') cat(param=ref ref='4')
  dxp(param=ref ref='11') race(param=ref ref='1') ;
  model group = dxp prioadjl cat numco_sf age2 male year pcs mcs;
  units age2=10 pcs=10/default=1;
  run;quit;*/
/*Model 3 unadj*/proc logistic data=manual3 descending;
  model group = year pcs mcs /RL lackfit RSQ ;
  units pcs=10 mcs=10/default=1;
  run;quit;
/*Model 2 adj*/proc logistic data=manual3 descending;
  model group = als ms scit scip stroke pd ampu copd arthri pgl pg2
pg3 pg4 pg5 pg6
  cat1 cat2 cat3 numco_sf age2 male black hisp indian haw as year pf
rp bp gh mh re sf vt/RL lackfit RSQ ;
  units age2=10 pf=10 rp=10 bp=10 gh=10 mh=10 re=10 sf=10 vt=10
/default=1;
  run;quit;
/*proc logistic data=manual3 descending;
  class prioadjl(param=ref ref='7') cat(param=ref ref='4')
  dxp(param=ref ref='11') race(param=ref ref='1') ;
  model group = dxp prioadjl cat numco_sf age2 male year pf rp bp gh
mh re sf vt;
  units age2=10 pf=10 rp=10 bp=10 gh=10 mh=10 re=10 sf=10
vt=10/default=1;
  run;quit;*/
/*Model 2 unadj*/
  proc logistic data=manual3 descending;
  model group = year pf rp bp gh mh re sf vt /RL lackfit RSQ ;
  units pf=10 rp=10 bp=10 gh=10 mh=10 re=10 sf=10 vt=10 /default=1;
  run;quit;
  /*Model 1*/proc logistic data=manual3 descending;
  model group = als ms scit scip stroke pd ampu copd arthri
  numco_sf year pf mh /RL lackfit RSQ;
  units pf=10 mh=10 /default=1;
  run;quit;
/*proc logistic data=manual3 descending;
  class dxp(param=ref ref='11');
  model group = dxp numco_sf year pf mh ;
  units pf=10 mh=10/default=1;
  run;quit;*/

```

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