Home and Community Based Services: Who is Using Them and Can They Prevent Hospital Admission?

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Abstract

This dissertation focuses on how home and community-based services (HCBS) influences the well-being of disabled elderly Medicaid recipients in Pennsylvania. Specifically, this dissertation examines different recipient characteristics associated with different lines of HCBS and if specific services are associated with a higher or lower risk for experiencing a hospitalization. The public health relevance of this dissertation is that it examines how functional support of elderly people can prevent hospital admission. By preventing hospital admission, HCBS can help people maintain living independently.

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Preface

Writing this dissertation and getting through graduate school has been one of the most challenging experiences of my life. Now that I am at the end of this season of life, I am filled with gratitude for the people who have supported me and for all of the lessons I have learned along the way. This process has taught me just as much about myself as it has about public health and as I move forward into my next career I hope that I can take the lessons I have learned in school to contribute to making a more just and kind world.

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To my students, you imparted me the notion that teaching is just as much about building a relationship as it is imparting knowledge. I hope I taught you as much as you taught me. I will always have a special place in my heart for the MPH/MHA class of 2019 and I cannot wait to see how you all will change the world.

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1.0 Introduction

This dissertation contains three studies on home and community based service (HCBS) use by elderly and disabled Pennsylvanians enrolled in Medicaid. All of these studies intended to examine one aspect of HCBS and how these services can promote independent living for elderly people. My hope is that this dissertation can contribute to a larger discussion on how Medicaid can support the health and wellbeing of elderly people as they age.

2.0 Chapter 1: Patterns of Home and Community Based Service Use by Beneficiaries Enrolled in the Pennsylvania Medicaid Aging Waiver

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2.1 Abstract

Background

Home and Community Based Services (HCBS) can be tailored to support a person's unique needs as he or she ages. Different forms of HCBS offer different types of support. The central service in most HCBS programs is Personal Assistive Services (PAS), also known as attendant care, but other forms of HCBS like adult day care and home delivered meals can provide benefits that allow a person to successfully live independently as they age. Previous research has focused on a single line of HCBS or has made a monolithic comparisons between HCBS populations and other populations. This study examines how much of each service is being used, the populations using each service(s), and if increases in the amounts of services used are associated with increases in disability level or differences in living status.

Methods

This is a descriptive cross sectional analysis examining HCBS use among elderly Pennsylvanians from 2014 – 2016 enrolled in Pennsylvania's 1915(c) Medicaid aging waiver program. The data for this study came from Pennsylvania Medicaid claims, enrollment files, and enrollee evaluations. This analysis uses logistic regression and OLS regression to see what disability traits and participant characteristics were associated with use of PAS, adult day care, and home delivered meals.

Results

People with Alzheimer's or a related Dementia were more likely to use adult day care and higher amounts of PAS but were less likely to use home delivered meals. People with higher ADL and IADL limitation were more likely to use higher amounts of PAS but were less likely to use adult day care and home delivered meals.

Conclusions

People who had higher levels of disability on average used more hours per day of PAS but were not necessarily more likely to use adult day care or home delivered meals. People who lived alone on average used more hours of PAS and were more likely to use home delivered meals but were not necessarily more likely to use adult day care. This suggests that, in addition to disability level, people's preferences play an important role in determining how their HCBS programs are designed. Future research needs to investigate what people's preferences are and how those preferences translate into the actual HCBS a person receives.

2.2 Background

Creating long-term care programs that support aged and disabled people living independently requires attention to the unique needs of the disabled individual (Kane 2001). Older adults prefer to live independently and as the population ages, the demand for home and community based services (HCBS) will continue to grow (Ng, Harrington et al. 2014, Ng, Harrington et al. 2015). The primary goal of HCBS is to enable people with physical and cognitive disabilities and limitations to age in their own homes rather than a nursing home (Duckett and Guy 2000). HCBS can assist people with accomplishing activities of daily living, managing of medications, emotional and social support, and environmental modifications in the individual's home. In order to support a person living independently, HCBS must compensate for the loss of functioning experienced with the onset of disability (Verbrugge and Jette 1994). This support must be tailored to the unique health needs, home setting, and personal desires of the individual (Vertrees, Manton et al. 1989, Degenholtz, Kane et al. 1997, Kane, Kane et al. 1998). This study seeks to understand what types of HCBS people in a 1915(c) Medicaid aging waiver program are using and if there are any identifiable patterns between service use and disability or living situation.

HCBS is a preferred form of LTSS compared to living and receiving services in a nursing facility (Kane 2001, Marek, Popejoy et al. 2005, Wieland, Boland et al. 2010, Hahn, Thomas et al. 2011). The use of HCBS has consistently grown over the past 30 years and is expected to continue growing (Shirk 2006, Thompson, Nadash et al. 2016) as the population ages and as federal and state governments continue to rebalance long-term care away from institutional care. There is a growing body of literature that examines outcomes associated with specific types of HCBS. Personal care, also known as attendant care or Personal Assistive Services (PAS) has demonstrated the ability to preserve an elderly person's autonomy and reduce the risk hospitalization (Cohen

1988, Townsend, Piper et al. 1988, Doty, Mahoney et al. 2010). Recent studies have found that providing meals to HCBS beneficiaries can delay placement in a nursing home (Thomas and Mor 2013, Sahyoun and Vaudin 2014, Campbell, Godfryd et al. 2015). Previous studies of adult day care programs have found high levels of user satisfaction (Ellen, Demaio et al. 2017). Past literature on adult daycare centers has demonstrated that they have the ability to provide respite to care givers as well as supporting the people who visit them, but the evidence that they can prevent or delay a nursing home placement is less clear. (Gaugler, Jarrott et al. 2003, Gaugler, Kane et al. 2003, Gaugler, Kane et al. 2005). Notwithstanding this growing body of knowledge, there is limited research on the actual type and amount of HCBS used by community-dwelling disabled elderly. This paper therefore investigates whether a Medicaid enrollee's disability characteristics and living arrangements are associated with specific types of HCBS use.

2.3 Conceptual Framework

Disability is the permanent loss of physical function or onset of a cognitive limitation. The purpose of HCBS is the compensate for a loss of function such that the recipient can continue living independently (Verbrugge and Jette 1994). Since personal care is intended to provide assistance with instrumental and basic activities of daily living, we hypothesize that higher levels of physical disability will be associated with higher use of personal care, also known as PAS or attendant care. People with a cognitive impairment typically require constant supervision. This can be extremely burdensome for family members. Thus, we hypothesize that adult day care, which provides a structured and monitored environment, will be used by individuals with lower levels of cognitive function. In addition, people with cognitive impairment may be able to feed

themselves but lack the executive function necessary to prepare a meal. Thus, we expect people with some loss of cognitive function to be more likely to use delivered meals.

Informal care giving from family members is the most common form of in home support for elderly people (Stone, Cafferata et al. 1987, Doty 2000, Parker, Horowitz et al. 2015, Schulz, Eden et al. 2016). People living with another person who can potentially help them with activities of daily living and instrumental activities of daily living will likely use require less time from an attendant or personal care aid and home delivered meals. Thus, we hypothesize that people living alone will be more likely to use all forms of HCBS.

2.4 Methods

This study was a pooled cross-sectional analysis examining HCBS use among community-dwelling disabled elderly Pennsylvanians from 2014 – 2016 who were enrolled in the 1915(c) Medicaid aging waiver program. The data are from Medicaid enrollment files, Medicaid claims files, and eligibility determination assessments.

2.4.1 Data

The data for this analysis came from Pennsylvania Medicaid enrollment claims, Medicaid claims of service use, and disability assessments of Medicaid enrollees administered in order to determine a person's level of need and determine their eligibility to receive Medicaid funded HCBS. The unit of observation in this study is the person-month. Each person in the data was

identified by an anonymized ID number. This number linked the enrollment data, service data, and eligibility determination data.

The enrollment data was used to determine when a person began and ended his or her participation in the waiver program. The enrollment data also included information regarding a person's race, ethnicity, gender, age, and the zip code and county where the person lived. To be enrolled in the aging waiver a person must demonstrate nursing facility eligibility and be at least sixty years of age or older. People who were in a different Medicaid waiver program prior to turning sixty and then transferred to the 1915(c) aging waiver were not included in this analysis due to being systematically different than the rest of the aged population receiving HCBS.

This analysis focuses on the three most common service categories: Personal Attendant Service (PAS), Home Delivered Meals, and Adult Day Care. Each service category is billed differently depending on the nature of the service. PAS is billed in 15 minute increments; we aggregated these bills to calculate the average minutes per person per day of PAS used by each person each month. Home delivered meals was measured as a binary indicator noting if the person did or did not receive a home delivered meal that month. Adult day care use was also measured as a binary indicator that noted if a person did or did not go to an adult day care center during a given month.

The unit of analysis was the person-month. The span of our observation went from July 2014 to December 2016, so one person could have a maximum of 30 person-months and a minimum of one person-month. In order to have a person-month included in the analysis, that person-month had to have a claim for one of the three services.

Physical and cognitive function was extracted from eligibility assessments conducted by the Area Agencies on Aging (AAA). These assessment are used to determine if an individual is

eligible for Medicaid HCBS Waiver services and are repeated on an annual basis to assure continued eligibility. In addition, assessments may also be conducted for individuals who's health or functional status has changed and they may require additional services. From these data we extracted measurements of limitations with regard to urinary and fecal continence, activities of daily living (ADL), and instrumental activities of daily living (IADL). The measurements of continence, ADLs, and IADLs were weighted based on a magnitude estimation score and then converted into a zero to ten scale (Finch, Kane et al. 1995, Barnato, Albert et al. 2011). A zero indicates no limitation in a particular domain, and a 10 indicates complete assistance required for all aspects of the domain. When examining continence, we looked at bladder control, bowel control, and if applicable the ability to manage an ostomy bag. When examining activities of daily living (ADL), we counted limitations regard eating, bathing, toileting, transfer, walking indoors, and dressing. The instrumental activities of daily living (IADL) measured were house work, walking outside, managing money, using a telephone, preparing meals, and shopping. We also had three indicators to note a previous diagnosis of Parkinson's disease, a previous diagnosis of Alzheimer's disease or a related dementia, and previous experience of a stroke, we included indicators of stroke and Parkinson's disease, since both conditions can be associated with significant levels of dependence. Finally, the measurement of cognitive impairment was limited to a diagnosis of Alzheimer's Disease or other form of Dementia (ADRD).

In addition to measurements of disability, we captured details of the individuals' living arrangements. These measurements indicated if a person lived alone, if the person lived with an adult child, with another adult, with a spouse, or with another family member. Nearly all people who were married were living with their spouse, but in order to be counted as living with a spouse a person had to indicate that he or she was living with his or her spouse. If a person was married

but classified him or herself as living with a child, other family member, or other adult, we classified that person as living with the adult child, other family member, or other adult, not as living with the spouse.

Finally, we include indicators for the region of the state and whether individuals lived in a rural or urban community. Rurality was defined by the National Center for Health Statistics Urban-Rural Continuum Codes (RUCC) that classifies counties based on their population and their proximity to an economic center (Hall, Kaufman et al. 2006). We dichotomized this scale into two variables, one indicating if the person lived in an urban area and one indicating if the person lived in a rural area. We also included an indicator as to whether or not a person lived in South West Pennsylvania (Pittsburgh and surrounding counties), South East Pennsylvania (Philadelphia and surrounding Pennsylvania counties), or in the primarily rural central and northern counties.

2.4.2 Analysis

A univariate analysis was performed to gain a picture of the demographic variation, differences in disability levels, and the differences in living arrangements of the enrollees in the aging waiver. We also examined the distribution of service use by unique individuals and at the person-month level.

A multivariate analysis was performed to examine the demographic characteristics and disability indicators that were associated with use of PAS, adult day care services, and home delivered meals. Use of PAS was measured as a continuous variable so the level of association between PAS use and individual characteristics is evaluated using ordinary least squares. When examining how certain person-level details were associated with PAS use, the outcome variable was the average number of minutes per day of PAS that was received. When examining variation

in adult day use, the outcome variable was a binary variable indicating whether or not a person had any claims for adult day care during that month. The measured association between adult day care use and individual characteristics is evaluated using a logistic regression. When examining patterns of in home delivered meal use, the outcome variable was also a binary variable indicating whether the person that month had any claims for home delivered meals. The measured association between home delivered meal use and individual characteristics is evaluated using a logistic regression. All regressions used sandwich estimators to control for multiple observations on the same individuals.

Since assessments are conducted annually, we also included a measurement of the number of months enrolled in the waiver program to control for other time related factors that might be affecting a person's service choice.

2.5 Results

The total number of people observed was 36,193 (see Table 1). The total number of person-months observed was 578,318. The population observed was 72.8% female, 48.8% white and 89.1% lived in an urban area. The majority of people (56%) lived in the Central or Northern Pennsylvania. The most common cognitive limitation was Alzheimer's Disease or a related Dementia which affected 22% of the population, while 20% of the population had experienced a stroke and 3% of the population had been diagnosed with Parkinson's Disease. The majority of the population either lived alone (43%) or lived with a child (22%), 15% of people lived with another family member, 13% lived with a spouse, and 8% lived with another person.

The majority of person-months (97%) had some PAS use (Table 2). Of the 15,570 person months that did not use any PAS, 10,779 were person months that used home delivered meals and 5,268 of the person months used adult day care. Exactly half (50%) of the population used up to four hours of PAS per day, while 37% used between four and eight hours of PAS per day and the remaining 10% of the population used over eight hours of PAS per day. There were 8.5% of person-months that had a claim for adult day care and there were 28% of person-months that had a claim for a home delivered meal (see Table 2).

Table 3 presents results of the multivariate analysis. Compared to men, women used on average 11 more minutes more of PAS per day ($p < 0.001$). Compared to white people, African Americans and Asian Americans used more minutes of PAS per day (17.5; $p < 0.001$ and 16.9; $p < .001$). Compared to people living in Southwestern Pennsylvania, people in Central and Northern Pennsylvania on average used 45 minutes more PAS per day ($p < 0.001$) while people living in the Southeast on average used almost 16 fewer minutes of PAS per day ($p < 0.001$). When compared to people without Alzheimer's disease or a related Dementia, people with a diagnosis of Alzheimer's Disease or a related Dementia used on average 41 more minutes of PAS per day ($p < 001$). Compared to people without a diagnosis of Parkinson's disease, people with a diagnosis of Parkinson's Disease used on average 45 more minutes of PAS per day ($p<.001$). When compared to people who lived alone, people who were married and lived with their spouse used, on average 50 fewer minutes per person day of PAS ($p<.001$). When compared to people who lived alone, people who lived with a child used on average about 29 fewer minutes of PAS per person day ($p<.001$).

When examining use of adult day care, women were 7% less likely to use adult day care (OR 0.93, $p< 0.001$, 95% CI [0.90, 0.95]) compared to men. People who lived in rural areas were

55% less likely to use adult day care when compared to people living in urban areas (OR 0.45, p< 0.001, 95% CI [0.42, 0.49]). African Americans and non-black Hispanic people were 53% (OR 0.47, p<0.001, 95% CI [0.46, 0.48]) and 44% (OR 0.56, p<0.001, 95% CI [0.50, 0.62]), respectively, less likely to use adult day care compared to white people. Asian Americans were twice (OR 2.0, p<0.001, 95% CI [1.94, 2.06]) as likely to use adult day care compared to white people.

A person's ADL, IADL, and continence levels were significantly associated with use of adult daycare (Table 3). A 10% increase in continence and IADL levels were associated with a 1% (OR 1.01, p<0.001, 95% CI [1.007, 1.014]) and 15% (OR 1.15, p<0.001, 95% CI [1.14, 1.16]) increased likelihood of using adult daycare while having a 10% increase in a person's ADL level was associated with a 9% decrease in a person's likelihood of using adult daycare (OR 0.91, p<0.001, 95% CI [0.909, 0.919]). People diagnosed with Alzheimer's disease or a related Dementia were 104% (OR 2.04, p<0.001, 95% CI [1.99, 2.09]) more likely to use adult daycare.

When examining use of home delivered meals, women were 18% (OR 0.82, p<0.001, 95% CI [0.81, 0.83]) less likely to receive home delivered meals compared to men. Asian American were 83% (OR 0.17, p<0.001, 95% CI [0.16, 0.18]) less likely to receive home delivered meals when compared to white people. People of Hispanic ethnicity and African Americans were 41% (OR 1.41, p<0.001, 95% CI [1.39, 1.44]) and 18% (OR 1.18, p<0.001, 95% CI [1.12, 1.24]) respectively more likely to use home delivered meals when compared to white people. People who lived in a rural area were 35% (OR 1.35, p<0.001, 95% CI [1.32, 1.38]) more likely to use home delivered meals compared to people living in urban areas. A 10% increase in ADL and IADL levels were associated with a 3% (OR 0.97 , p<0.001, 95% CI [0.967, 0.973]) and 10% (OR 0.90, p<0.001, 95% CI [0.895, 0.904]) lower likelihood of using home delivered meals. People who

were diagnosed with Alzheimer's Disease or a related dementia were 2% (OR 0.98, p<0.001, 95% CI [0.96, 1.00]) less likely to receive home delivered meals when compared to people who did not have a diagnosis of Alzheimer's Disease or a related dementia. People living with a spouse were 42% (OR 0.58, p<0.001, 95% CI [0.57, 0.59]) less likely to use home delivered meals than people living alone. People living with an adult child were 44% (OR 0.56, p<0.001, 95% CI [0.55, 0.57]) less likely to use home delivered meals than people living alone. People living with another family member were 45% (OR 0.55, p<0.001, 95% CI [0.53, 0.56]) less likely to use home delivered meals than people living alone (see Table 3).

2.6 Discussion, Limitations, and Further Research

The objective of this paper was to examine how services were being used across the population and investigate to see if certain services were used more or less in specific subgroups. We found that people who lived alone were much more likely to use home delivered meals compared to anyone who lived with another person and on average used much less PAS than other people who lived with other family members. However, this finding was not consistent with regard to adult day care. People who lived with a spouse or another person were more likely to go to adult day care while people who lived with a child or another family member were less likely to go to adult day care.

We found that higher levels of disability measured with ADLs and IADLs were associated with higher PAS use but with lower use of home delivered meals. While higher levels of disability might be associated with greater use of home delivered meals, we should note that one of the IADLs measured was meal preparation, and the increase in the amount of PAS associated with a

10% increase in IADL levels was 23 more minutes a day of PAS. This would average out to about a little over 2.5 additional hours of PAS a week, some of which time could be spent preparing meals that can be eaten later. How an aide spends his or her time and how that changes as a person becomes more disabled is an important topic for further investigation. People diagnosed with Alzheimer's Disease were much more likely to use adult day care and used an additional 41 more minutes of PAS. They were less likely however to use home delivered meals. The fact that people with a dementia related diagnosis used so much more PAS could be what caused the decreased use in home delivered meals. If an aid is spending an additional four hours and forty minutes with a person each week, some of that time might be devoted to meal preparation, decreasing a person's demand for home delivered meals. People with Parkinson's disease and people who had previously experienced a stroke were more likely to receive home delivered meals and were less likely to go to an adult daycare center. One factor that could influence these differences is that the adult day care centers may gear their services for people with Alzheimer's Disease and related dementia as opposed to other disabilities. The features of each adult day center was not known and is another important topic for future study.

The fact that elderly people who lived with either their children or other family members, people who could benefit from a respite from care giving, were less likely to go to an adult day center is surprising. Adult daycare has traditionally provided a respite from caregiving (Gaugler, Jarrott et al. 2003). The cause behind this difference is not something we can discern from our data. We were not surprised to see that people who lived with others were less likely to use home delivered meals, but the magnitude of the difference is somewhat unexpected. Delivered meals can potentially offer another form of respite for care givers cooking for the elderly person living with them. The fact that people who lived with another person were almost half as likely to use home

delivered meals could be a result of the fact that the types of meals offered for home delivery had food people did not prefer.

People who lived with a spouse used much less PAS per day than people living with an adult child or another family member. This is surprising because a spouse is less likely to be able bodied than a person's adult child. This difference in PAS use could be a result of the fact that, if both people in a couple are eligible for Medicaid, one home care aid might be able to tend to two people simultaneously. This analysis does find some surprising associations between service use and a person's living situation, findings that are not necessarily intuitive and should be investigated further.

Overall these findings reveal a complex set of associations between disability and HCBS use. Presence of cognitive disability or higher levels of physical disability were not associated with higher likelihood of using all types of HCBS. This was particularly the case for adult day care and home delivered meals. These findings clearly demonstrate that the process by which services are allocated to individuals is not simple but takes into account multiple factors in non-linear ways. Future research should examine the role of individual and cultural preferences as well as possible barriers to specific in the use HCBS.

2.6.1 Limitations

There are several limitations that should be acknowledged. First, we did not have a detailed picture of the social support system of people in our sample. We used living arrangement as a proxy for informal and family care giving, but we recognize that people may have other people in their lives who do support them but do not live with them. We recognize that many people receive substantial amounts of assistances from non-resident care givers. We also recognize that each

family is different and each family may not be capable of fully supporting an elderly relative living with them. Second, we restrict the analysis to three specific services based on the prevalence of these services. There are other services that HCBS users may value, but are used infrequently, leading to sparse data. Finally, we acknowledge that peer, community, and cultural values may affect an individuals' decisions around use of HCBS, such as use of adult daycare and home delivered meals. This is an important avenue for future research.

2.7 Conclusion

This paper highlights some important takeaways about HCBS use across an entire state Medicaid population. The first is that as people become more disabled, they tend to use more PAS, but higher levels of disability are not necessarily indicative of using more adult day care or home delivered meals. People living alone are much more likely to use more PAS but living alone does not necessarily predict a person's use adult day care, a service that should be a relief to caregivers. This suggests that other factors beyond disability and living situation could be affecting how people' HCBS plans. Demographic characteristics like race, ethnicity, and gender are known to play important roles in how people interact with the healthcare system and in this analysis, we did see that these characteristics were associated with the type and amount of service a person received but overall there was no consistent pattern of service use. This paper lays a possible foundation to examine further how people use HCBS and how these services can potentially allow a person to remain living and aging in their own community.

2.8 Tables

Table 1. Characteristics of Elderly Medicaid Waiver Participants (2014-2016)

Variable	Unique Individuals (n=35,873)		Person-Months (n=578,318)	
	n	% or Mean (SD)	n	% or Mean (SD)
Age	35,873	78 (9.2)	578,318	78 (9.2)
60-65	3,714	10%	48,361	8%
65-70	5,634	16%	92,276	16%
70-75	5,892	16%	97,938	17%
75-80	6,043	17%	100,973	17%
80-85	5,790	16%	95,440	17%
85+	8,800	25%	143,330	25%
Gender				
Female	26,353	72.8%	427,075	73.8%
Male	9,840	27.2%	151,243	26.0%
Race/Ethnicity				
Caucasian (Non-Hispanic)	17,687	48.8%	273,745	48.6%
Black (Non-Hispanic)	11,783	32.6%	196,799	34.0%
Hispanic	566	1.6%	8,965	1.5%
Asian	2,895	8.0%	48,118	8.3%
Other	3,262	9.0%	50,691	8.8%
Geographic Region				
Southwest	5,879	16.2%	90,704	15.7%
Central and Northern	20,412	56.4%	341,989	59.1%
Southeast	9,902	27.4%	145,625	25.2%
Location				
Urban	32,255	89.1%	518,922	89.7%
Rural	32,255	10.9%	59,396	10.3%
Disability Level				
Continence	3.7	3.3	3.7	3.3
Instrumental Activities of Daily Living	3.5	1.6	3.4	1.6
Activities of Daily Living	6.3	2.4	6.3	2.4
Cognitive Function				
Alzheimer's Disease or Related Dementia	8,210	22.6%	127,075	22%
Stroke	8,210	19.8%	113,491	20%
Parkinson's Disease	1,182	3.3%	18,792	3%

Table 1 Continued

Living situation				
Lives Alone	14,947	41.1%	246,293	43%
Lives with Child	8,092	22.4%	128,261	22%
Lives with another person	3,094	8.6%	45,842	8%
Lives with spouse	4,525	12.5%	72,804	13%
Lives with other family	5,436	15.1%	85,118	15%

Table 2. Distribution of HCBS Service Use

	Unique Individuals		Person- Months	
Services Use	n	%	n	%
Minutes of PAS per day				
None	1,666	4.6%	15,570	2.7%
> 0 and <= 240	19,802	55.2%	289,838	50.1%
> 240 and <= 480	11,542	32.2%	214,784	37.1%
> 480	2,876	8.0%	58,126	10.1%
Home Delivered Meals per week				
None	25,568	71.3%	8,766	71.8%
> 0 Meals	10,318	28.7%	163,343	28.2%
Adult Day Care per week				
None	33,292	92.8%	529,224	91.5%
> 1 day	2,594	7.2%	49,094	8.5%

Table 3. Factors Associated with HCBS

	Personal Attendant Care		Adult Day Care			Home Delivered Meals		
	Coefficient	P>t	Odds Ratio	95% Conf. Int.		Odds Ratio	95% Conf. Int.	
Gender (Male)								
Female	11.31	<0.001	0.93	0.90	0.95	0.82	0.81	0.83
Race (White)								
Black	17.51	<0.001	0.47	0.46	0.48	1.42	1.39	1.44
Non-Black Hispanic	-5.23	0.006	0.56	0.50	0.62	1.18	1.12	1.24
Asian	16.88	<0.001	2.00	1.94	2.06	0.17	0.16	0.18
Other Race	18.12	<0.001	0.40	0.38	0.42	1.05	1.03	1.08
Geography (Urban)								
Rural	-8.95	<0.001	0.45	0.42	0.49	1.35	1.32	1.38
Age Category								
65<-70	-9.10	<0.001	1.51	1.41	1.62	0.90	0.88	0.93
70<-75	-14.07	<0.001	2.11	1.97	2.25	0.83	0.81	0.86
75<-80	-15.38	<0.001	3.07	2.88	3.28	0.68	0.66	0.70
80<-85	-11.99	<0.001	3.10	2.90	3.30	0.70	0.68	0.72
85+	1.82	0.082	2.93	2.74	3.12	0.63	0.62	0.65
Region (Southwestern PA)								
Eastern PA	-16.48	<0.001	6.26	5.99	6.55	0.45	0.44	0.46
Northern and Central PA	45.23	<0.001	0.82	0.78	0.87	0.72	0.70	0.73

Table 3 Continued

Time Observed in the Data	1.13	<0.001	1.01	1.01	1.01	1.00	0.99	1.00
Disability Level								
Continence Level (%)	4.41	<0.001	1.01	1.01	1.01	1.01	1.01	1.01
Activities of Daily Living	17.54	<0.001	0.91	0.91	0.92	0.97	0.97	0.97
Instrumental Activities of Daily Living	23.50	<0.001	1.15	1.14	1.16	0.90	0.89	0.90
Alzheimer's or Related Dementia Diagnosis	40.84	<0.001	2.04	1.99	2.09	0.98	0.96	1.00
Has experienced a Stroke	-1.35	0.049	0.99	0.97	1.02	1.09	1.07	1.11
Parkinson Diagnosis	44.93	<0.001	0.96	0.90	1.02	1.13	1.09	1.17
Living Situation (Lives Alone)								
Lives with a Spouse	-50.06	<0.001	1.30	1.26	1.35	0.58	0.57	0.59
Lives with Child	-28.49	<0.001	0.97	0.94	1.00	0.56	0.55	0.57
Lives with other family	-21.73	<0.001	0.94	0.90	0.97	0.55	0.53	0.56
Lives with another person	-13.80	<0.001	1.17	1.12	1.22	0.64	0.62	0.65
Constant	57.13	<0.001	0.01	0.01	0.01	2.21	2.14	2.29

3.0 Chapter 2: Risk of Hospitalization Associated with Different Constellations of Home and Community Based Services

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3.1 Abstract

Background

Elderly individuals generally prefer support from Home and Community Based Services (HCBS) rather than living in a nursing home. Previous literature however has noted that people receiving HCBS face an elevated risk of hospital admission compared to people living in a nursing home. This increased risk is concerning because, for elderly people, a hospital admission may often precipitate a nursing home placement. The goal of HCBS is to support people living independently as they age. In order to achieve this, the risk of hospitalization needs to be minimized. Previous studies of HCBS and hospitalizations have made monolithic comparisons between populations receiving HCBS and populations living in a nursing home. Unlike a nursing home however, the scope of services offered in an HCBS program vary and often individuals in an HCBS program can use different combinations or constellations of in home services to support their needs. This paper examines the risk of hospitalization associated with different constellations of HCBS to see how the risk of hospitalization varies across different services.

Methods

The data for this study came from Pennsylvania Medicaid claims, enrollment files, enrollee evaluations, and Medicare and Medicaid hospitalization records. This analysis compared the risk of acute care inpatient hospitalization across an entire state Medicaid population of community dwelling elderly individuals using different forms of HCBS. Twelve different constellations of HCBS were identified, each composed of different amounts and types of in-home services. Using a logistic regression, we derived predicted probabilities of experiencing a hospitalization for people in each constellation of HCBS. As a comparison, this analysis also included a group of

community dwelling elderly people who applied to for HCBS and were deemed ineligible for the Medicaid funded service.

Results

The highest risk of hospitalization, 15.1%, was associated with use of home delivered meals and low levels of PAS. The lowest risk of hospitalization, 7.5% was associated with use of adult day care and low levels of PAS. An 11.6% risk of hospitalization was associated with people who had applied to receive HCBS but were deemed ineligible. This risk was higher than all other constellations of HCBS except for the risk associated with using only low levels of PAS (13.9%) and using low levels of PAS and home delivered meals (15.1%).

Conclusions

People who received medium and high levels of PAS saw a decrease in their risk of hospitalization. Offering a higher initial level of PAS to consumers when they enroll in Medicaid funded HCBS could potentially reduce the risk of hospitalization. People receiving home delivered meals seemed to have the highest risk of hospitalization, though previous literature suggests these individuals are likely to live alone, so problems regarding isolation could be what is behind this increase in hospitalization risk. More research is needed to understand how people are constructing their HCBS programs and the specific benefits produced by each constellation of service.

3.2 Background

America's aging population poses a challenge of size and scope the American healthcare system has never before seen. Ensuring both the seventy seven million Baby Boomers and future generations can age with minimal upset to their life style will require a high degree of planning and thoughtfulness towards the unique health concerns each individual faces as he or she ages (Pollard and Scommegna , Knickman and Snell 2002, Canizares, Gignac et al. 2016). Ideally older Americans can continue to live independently rather than in a nursing home as they age (Kane, Kane et al. 1998). This is a challenging task because each person has distinct health needs, environmental limitations, and personal goals that need to be supported throughout old age (Kane 2001). The system for administering this care must also be financed so that the costs do not become unmanageable (Dumont, Oh et al. 2018). Long-term care costs recently topped $300 billion, over 70% of which was covered by some form of public payer (Reaves and Musumeci 2015). One proposed strategy to provide high quality long term services and supports (LTSS) at a sustainable level is to shift care more towards home and community based services (HCBS). HCBS can be designed on a person by person basis to support each individual's unique health needs and limitations. HCBS is an alternative to care in a nursing facility and can support a person to live independently. (Vertrees, Manton et al. 1989, Degenholtz, Kane et al. 1997, Kane, Kane et al. 1998, Duckett and Guy 2000). In addition to being flexible to a person's unique health and disability requirements, HCBS is much less expensive than placing that person in an nursing home (Reaves and Musumeci 2015). Given its relative low cost and ability to uniquely support individuals living independently, HCBS is an important policy option to address the growing need of an aging population.

The scope of HCBS is to support a person's functional needs and everyday living. The in home services that aid people are not staffed by trained clinicians and are not designed to provide medical care. A potential problem with only providing functional support is that some elderly people cannot effectively manage their own health needs and will face health risks that are not being addressed, which could lead to potential adverse health events. Three studies have found that HCBS recipients face a higher risk of being admitted to the hospital compared to people living in a nursing home (Konetzka, Karon et al. 2012, Wysocki, Kane et al. 2014, Newcomer, Ko et al. 2016). Going to the hospital is not only a highly unpleasant and costly event, but often for elderly people, being admitted to the hospital may lead to a permanent nursing home placement (Wolinsky, Callahan et al. 1992, Rudberg, Sager et al. 1996, Friedman, Steinwachs et al. 2005). If HCBS is to support people living independently, it must do all it can to support people's functional needs to prevent worsening health conditions and hospital visits. If HCBS is not adequately addressing the risk of hospitalization, then it is not supporting people to live independently nor is it lowering costs of care for these individuals (Konetzka 2014).

Examining how hospitalization risk varies across a population and how it is associated with different types of HCBS is important because, by its very nature, HCBS differs from person to person. People enrolled in an HCBS program can choose a number of different services, some of which may be more protective against a hospitalization than others. There have been some studies of comprehensive HCBS programs such as Aging in Place (AIP) and the Program for All-inclusive Care for the Elderly (PACE) that have demonstrated broad benefits, e.g., improved physical functioning, decreased risk of hospitalization, and increased satisfaction with the healthcare system (Chatterji, Burstein et al. 1998, Marek, Popejoy et al. 2005, Rantz, Phillips et al. 2011). These studies compare HCBS users and to non-HCBS users, but do not examine any variation within the

HCBS program nor what specific services or combinations of services are associated with program outcomes.

There has been prior research studying outcomes associated with the individual services typically included in HCBS programs. Attendant care or personal assistive services (PAS), which is care administered by a non-medical aid to help with basic and instrumental activities of daily living and support a person's health, is one of the most commonly used in home services (Doty, Kasper et al. 1996, LeBlanc, Tonner et al. 2000, Kitchener, Ng et al. 2007). PAS has been shown to protect against hospitalizations as well as support a person's autonomy (Cohen 1988, Townsend, Piper et al. 1988, Assistant Secretary for Planning and Evaluation 2016). Two studies focused on nutrition for elderly people found that providing delivered meals to HCBS beneficiaries decreased their likelihood for admission to a nursing home and supported a person living independently (Thomas and Mor 2013, Sahyoun and Vaudin 2014). Studies have shown that of adult day care is associated with improved psychological outcomes (Ellen, Demaio et al. 2017).

One common finding with regard to expansion of HCBS programs is the "Woodwork Effect" (Harrington, Ng et al. 2011, LaPlante 2013). States expanding their HCBS programs find that those who qualify for both HCBS care and institutional nursing care will participate in HCBS programs at much higher rates compared to nursing home programs. These findings suggest that HCBS services have perceived benefits that are not found in a nursing home. All of these studies are important because they highlight the benefits of HCBS. While evidence of a Woodwork Effect suggests HCBS expansion might increase costs rather than offset more expensive nursing home use, evidence that HCBS can reduce hospitalization might demonstrate other financial benefit to public payers.

Looking within an HCBS program at a more granular level is important since the flexibility of HCBS programs means that individual consumers might be receiving substantially different combinations of services. The actual 'intervention' might be different depending on the needs and preferences of the individuals. In addition, there is reason to think that different constellations of in-home services may provide benefits beyond what can be seen focusing on a single service line or focusing on a whole population. Some services may have complementary benefits when combined with other services and some may have additional benefits when used in higher quantities. Since we suspect that people use different quantities and combinations of services to address their own unique cognitive and physical limitations, there is a research gap in examining how these constellations of HCBS help people remain independent. Given that hospitalization can often lead to a nursing home placement, understanding what constellations of HCBS can potentially decrease risk for hospitalization is important in understanding how HCBS can support a person living independently (Friedman, Steinwachs et al. 2005, Walsh, Wiener et al. 2012, Pierluissi, Francis et al. 2014).

This study addresses this research gap by examining the risk of hospitalization associated with the different constellations of HCBS within the Pennsylvania 1915(c) Medicaid Waiver. This study will use data from Medicare and Pennsylvania Medicaid. This study will identify what services in an HCBS program can complement each other by providing additional protection from going to the hospital, or if specific services are more effective when administered at higher levels.

3.3 Methods

This study is a cross sectional analysis examining how constellations of HCBS are associated with risk of experiencing an acute inpatient hospitalization among disabled elderly Pennsylvanians. The study period ranges from June 2014 to December 2016. We used logistic regression to estimate the association of hospitalization associated with selected constellations of HCBS. The results are presented as predicted probabilities to facilitate meaningful comparisons of the different services, controlling for individual factors that are associated with the risk of hospitalization.

Included in this analysis was a reference group of community dwelling elderly people who had applied to receive HCBS but had been deemed ineligible for Medicaid funded HCBS. This group was included for a number of reasons. First, this reference category provides an estimate of the risk of hospitalization for people with known level of physical and cognitive limitations but are not receiving paid HCBS. Although this group is less disabled than people who were deemed eligible for Medicaid HCBS, they were experiencing sufficient need that they applied for services. Thus, they are more similar to program users than the general aged or even general dual eligible population. This is not a perfect comparison group (there is no randomization taking place and these people are less disabled) but within our data this group is the most similar population to those receiving HCBS that can potentially point to a counterfactual where HCBS is not provided. If people using HCBS have a significantly lower risk of hospitalization than people less disabled living in the community and not receiving HCBS, this suggests that the HCBS is providing some health benefit. Second, as previous literature on the "Woodwork Effect" has identified, there are a number of people who will use HCBS services if offered them but will not use Medicaid funded institutional nursing care (Harrington, Ng et al. 2011, LaPlante 2013). If HCBS is capable of

decreasing risk of hospitalization, then the potential increase in cost associated with expanding an HCBS program due to the Woodwork Effect could be partially offset by the corresponding decrease in risk of hospitalization and subsequent nursing home placement. By examining the potential decrease in risk associated with providing people with HCBS, we can begin to understand the size of the potential cost savings incurred by expanding access to in home services for elderly people. Finally, inclusion of this comparison group is consistent with previous research on HCBS and hospitalization risk (Chatterji, Burstein et al. 1998).

3.3.1 Data

The data for this study came from the Pennsylvania Department of Human Services. The unit of observation was the person quarter. This measure had been used in previous studies of hospitalization in HCBS populations (Wysocki, Kane et al. 2014). The measure is granular enough to examine variation in service use but avoids a zero mass problem with using a shorter time period (e.g., person-month). The earliest a person can be observed in our data is July of 2014 and the latest a person could be observed in our data is December of 2016. To be counted as receiving HCBS the person needed to be enrolled in the waiver for the whole quarter and receive some HCBS during that quarter. If a person transitioned into a nursing facility from the waiver program or died while in the waiver program, the person quarter in which they left the program was removed but the rest of their person quarters in which they were living in the community receiving HCBS remained in our dataset. This study also used data from Medicaid enrollment files and Medicaid fee for service claims to observe HCBS use. This study used data from both Medicare and Pennsylvania Medicaid concerning a person's experience being hospitalized and data regarding the chronic diseases with which each person in our data had been diagnosed.

In order to qualify to receive HCBS under Pennsylvania's 1915(c) waiver, a person must meet eligibility requirements: the individual must have limitations with regards to activities of daily living, he or she must be recommended by a physician to live in a nursing home, and their income must be no greater than 300% of the federal poverty level (Pennsylvania Department of Aging 2018). The assessments to determine eligibility were conducted by the local area agency on aging in partnership with the Pennsylvania Department of Human Services. Re-assessments are conducted annually or if a person has a change in status and requires changes to their service plan. The eligibility assessment data includes individuals who were not determined to be eligible for waiver services.

Assessment data included ability to control bowels and bladder, and if necessary, manage an ostomy bag. Activities of daily living (ADL) captured limitations with eating, bathing, dressing, transfer, toileting, and walking indoors. Instrumental activities of daily living (IADL) captured limitations with housework, walking outside, managing money, using a telephone, preparing meals, and shopping. We applied a magnitude estimation weights to construct a continuous measure of limitation with continence, ADLs, and IADLs that has ratio scale properties (Finch, Kane et al. 1995, Barnato, Albert et al. 2011). For ease of comparison, each measure was converted to a zero to ten scale. A zero represented total independence (no limitations) and a ten represented total dependence (completely limited in all tasks).

The assessment data include a description of the person's living arrangement (living alone, with a family member, an adult child, or another person). Measurement of cognitive function was limited to presence of a diagnosis of Alzheimer's disease or related dementia.

This study used enrollment data to identify the people enrolled in the 1915(c) waiver program and their length of enrollment. This study identified individual people by an anonymized

ID number assigned to them that functioned as a unique identifier. This number linked the enrollment data to all of the other data used in this study. The enrollment data had information about the person's basic demographics including age, rurality, county of residence, gender, race, and ethnicity. This information was broken up into person quarters. While people can be enrolled in Pennsylvania's aging waiver as young as age 60, we limited the people in our study to people who were dually eligible for Medicare and Medicaid, so the youngest people in this study were 65. Enrollees who had previously been enrolled in other disability related waivers prior to being enrolled in the aging waiver were not included in our data set. The needs of these individuals would be systematically different than people who entered the aging waiver for reasons related to aging.

We focused on three specific services that were used most frequently in our data and are important components of all HCBS programs (Wiener, Tilly et al. 2002): Personal attendant Services (PAS), Home Delivered Meals, and Adult Day Care. These services are billed on a per encounter basis. PAS is billed in 15 minute increments; we calculated the average minutes per day per quarter. Home delivered meals and adult day care are billed per meal or per day (respectively). Due to the distribution of these data (low prevalence), these were covered to binary measurements, indicating if that person any home delivered meals or adult day care during the person quarter.

This study also used information from Medicare and Medicaid on the number of diagnosed chronic conditions for each person. This information was then converted into a count of chronic conditions to indicate the overall burden of chronic disease.

The outcome of interest was risk for experiencing an acute care inpatient hospitalization. Data on this came both from Medicaid and Medicare claims. This was a binary variable indicating of a person had or had not experienced a hospitalization during that quarter. Our analysis was limited to people who were enrolled in fee for service Medicaid and fee for service Medicare.

3.3.2 Analysis

This study examines how the risk of hospitalization is associated with different constellations of home and community based services. In order to do this, we first had to construct constellations of HCBS. We constructed these constellations based on the services that were used with enough frequency and consistency during the observation period and across the population. The services that met this criteria were home delivered meals, adult day care, and personal assistive services (PAS) also known as attendant care. Respite services were offered through the HCBS program, but our data showed that fewer than 3% of the population used these services. Other services, like emergency response and home modification were used with higher frequency, but often these services are billed such that we never observe the actual use of the services by the beneficiary. Home modification is billed at the time of installment and we do not see how much it is or is not used after installation. Emergency response is billed at monthly intervals regardless to whether or not the person uses it. PAS, adult day care, and home delivered meals were used consistently and were used frequently enough by people across the commonwealth of Pennsylvania make up the constellations of HCBS. To be included in this analysis a person had to one of these three services.

The service central to many HCBS programs is attendant care or personal assistive services (PAS) (LeBlanc, Tonner et al. 2000, Kitchener, Ng et al. 2007) and 97% of the people in our analysis regularly used some sort of personal assistive services. The amount of PAS used however varied from an average of less than one hour of PAS per day to 24 hours of PAS per day. Since this service was used so frequently but at varied amounts, we decided to define people as being low PAS users, medium PAS users, and high PAS users. The reason to break this variable into different categories is because we suspect that the activities of the care giver will be different as

the care giver spends more time with the recipient. A care giver who spends more time with a person may be able to disproportionately devote more hours to activities that could prevent a hospitalization (Walsh, Wiener et al. 2012) where as a care giver who spends less time may need to focus most of his or her time on supporting activities of daily living. Low PAS users were people who used up to four hours of PAS per day or less than half of a work day. Medium PAS users were people who used PAS four to eight hours a day or between half and a full work day worth of PAS. High PAS users were people who used more than eight hours of PAS per day or more than one work day worth of PAS. In order to avoid a problem with skewed data, we decided to measure adult day care use and home delivered meal use with binary indicators.

We constructed the constellation of HCBS based on all of the possible combinations of each service. This produced twelve different constellations: 1) Only low levels of PAS, 2) low levels of PAS and adult day care, 3) low levels of PAS and home delivered meals, 4) low levels of PAS, adult day care, and home delivered meals, 5) only medium levels of PAS, 6) medium levels of PAS and adult day care, 7) medium levels of PAS and home delivered meals, 8) medium levels of PAS, adult day care, and home delivered meals, 9) only high levels of PAS, 10) high levels of PAS and adult day care, 11) high levels of PAS and home delivered meals, 12) high levels of PAS, adult day care, and home delivered meals.

There were a very small number of people who only used adult day care or home delivered meals and did not use any PAS. There was a concern that an individual with limitations regarding activities of daily living who declined using an in home aid may be systematically different than the rest of the population, so they were not included in our study.

This first analysis examined the total number of people in each constellations of HCBS as well as the number of people of each race, ethnicity, gender, and rurality in both samples. This

analysis also examined the average level of disability experienced by people in each group. The next analysis examined the total number of person quarters in every constellation of HCBS and the average rate of hospitalization for people in each HCBS constellation.

The final analysis was a logistic regression that produced predicted probability of hospitalization for people in each constellation of HCBS and for community dwelling dually eligible people who were not using Medicaid funded HCBS. The outcome variable was a binary variable indicating if the person had been admitted to the hospital at least once during the person quarter. The variable of interest was the constellation of HCBS that the person used during that quarter. This variable was a categorical variable with the reference category being those people who applied to receive Medicaid funded HCBS but were deemed ineligible for the service. Other covariates in the model were race, gender, age, rurality, location within the state of Pennsylvania, the person's level of continence, the person's ADL and IADL levels, the living situation of the individual (whether the person lived with a child, a spouse, another family member, another person, or alone), the number of diagnosed chronic conditions, and the number of quarters the person had been observed in our data. Since individuals could appear in the data set for multiple quarters, standard errors were clustered at the person level (Freedman 2006).

Two alternative models were run to further examine the association between risk of hospitalization and constellation of HCBS. The first alternative model run was a model that did not include the community dwelling elderly people and instead used people receiving only low levels of PAS as the reference group for the model. The second alternative specification was a generalized estimating equation that was used to further control for potential problems with heteroscedasticity.

3.4 Results

The descriptive statistics show that the majority of the people in our sample were female, white, and lived in urban areas (See Table 4). The average age of the people receiving HCBS was 79.3 (9.3) and the average age of the community dwelling elderly people not receiving HCBS was 75.8 (8.6) (see table 4). People receiving HCBS had a 3.04 higher ADL level ($p<0.001$), a 2.62 IADL level ($p<0.001$), and a 2.08 higher level of incontinence than those not enrolled in HCBS ($p<0.001$) (see Table 4). About one in five (19.2%) people used only low levels of PAS. Home delivered meals were used more frequently than adult day care. People using a constellation with either medium or high amounts of PAS made up 56% of the sample. Community dwelling elderly people not receiving any Medicaid funded HCBS were 37% of the sample.

Community dwelling elderly people not receiving any Medicaid funded HCBS had an unadjusted hospitalization rate of 11%. People receiving HCBS had a 14% risk of hospitalization. After adjusting for health, disability, demographic factors, community dwelling duals receiving no Medicaid funded HCBS faced an 11.6% (95% CI:11.3%, 11.9%) probability of experiencing a hospitalization (see Table 6). The predicted probabilities of hospitalization for people using HCBS ranged from 15.1% to 7.5% depending on a person's constellation of HCBS (see Figure 1).

Holding all other variables at their averages, people using only low levels (0<-4 hours) of PAS faced a 13.9% probability (95% CI:13.5%, 14.3%) of experiencing hospitalization. People using only medium (4<-8 hours) levels of PAS faced a 10.2% probability (95% CI: 9.8%, 10.6%) of experiencing a hospitalization. People using only high levels of PAS (8+ hours) face a 9.5% (95% CI: 8.8%, 10.1%) probability of experiencing a hospitalization (see Figure 1).

People using low levels of PAS and adult day care experienced a 7.5% probability (95% CI: 6.8%, 8.1%) of hospitalization. People using medium levels of PAS and adult day care faced

an 8.2% probability (95% CI: 7.2%, 9.2%) of experiencing a hospitalization. People using high levels of PAS and adult day care faced a 9.4% probability (95% CI: 5.9%, 12.9%) of experiencing a hospitalization (see Figure 1).

People using low levels of PAS and home delivered meals experienced a 15.1% probability (95% CI: 14.5%, 15.7%) of hospitalization. People using medium levels of PAS and home delivered meals faced a 10.7% probability (95% CI: 10.0%, 11.4%) of experiencing a hospitalization. People using high levels of PAS and home delivered meals faced a 10.2% probability (95% CI: 8.9%, 11.5%) of experiencing a hospitalization (see Figure 1).

People using low levels of PAS and both adult day care and home delivered meals faced a 10.1% probability (95% CI: 7.7%, 12.4%) of experiencing a hospitalization. People using medium levels of PAs, adult day care, and home delivered meals faced an 11.1% probability (95% CI: 7.7%, 14.4%) of experiencing a hospitalization. People using high PAS, home delivered meals, and adult day care faced a 13.2% probability (95% CI: 5.7%, 20.8%) of experiencing a hospitalization (see Figure 1).

3.5 Discussion

The first takeaway from this analysis is that people using high and medium levels of PAS face a lower risk of hospitalization than the community dwelling elderly people with no HCBS. People using only low levels of PAS and low levels of PAS and home delivered meals face a higher risk of hospitalization compared to community dwelling dual eligible people receiving no HCBS. The relatively high risk of hospitalization for people using low levels of PAS could be a result of a few different factors. One factor that may be causing this is that some people who are

eligible to receive HCBS may be resistant to getting any help and are possibly prone to underutilize the care offered to them. The most common constellation of HCBS, also happens to be the least intensive in terms of PAS. A fraction of HCBS users may be using the bare minimum amount of HCBS when using more hours of PAS or PAS in combination with other services might be more appropriate to support their needs. The fact that people using medium and high amounts of PAS face a lower risk of hospitalization compared to community dwelling elderly people with no HCBS and people using only low levels of PAS suggests that more hours of in home care can result in a lower risk of hospitalization. This topic merits additional research.

The second takeaway is that people receiving home delivered meals and PAS were at a slightly higher risk of hospitalization than people only receiving PAS. This was noteworthy because previous literature has found that providing a meal can prevent or delay a person's risk of nursing home placement (Thomas and Mor 2013, Sahyoun and Vaudin 2014). One potential cause of this elevated risk is that people who receive a home delivered meal are more likely to live alone and experience loneliness and isolation (Thomas, Akobundu et al. 2015). These individuals may not be managing their health needs or engaging a support system in an appropriate manner. Our data was limited in that the only measurement of isolation available to us was a person's living situation. Some people who live alone may have family who live very close or may have a tight social network that can support them. Others may not have any form of social support. Understanding the degrees of isolation people face and what services may be able to address that isolation is an important future research topic.

A third takeaway from this paper is that, at low levels of PAS, people using adult day care faced a lower risk of hospitalization than people only using PAS but as people received more PAS, their risk of hospitalization increased. The low risk of hospitalization faced by people who received

a small amount of PAS and went to an adult day care center could very well be a result of the fact that the adult daycare center provided beneficial support and offered some respite to the in home care givers or family member supporting the individual. This could also be a result that people with some cognitive impairment and mild physical limitations face a relatively low risk of hospitalization. People using higher amounts of PAS and adult day care may also have more severe cognitive impairment and physical limitations and face a concomitantly higher risk of hospitalization. Our measure of cognitive impairment was limited to a binary indicator measuring if a person had or had not been diagnosed with Alzheimer's Disease or a related Dementia. A more detailed measurement of cognitive impairment would better gain insight into how services like adult daycare can support elderly individuals.

Previous literature on the topic of HCBS and hospitalization has suggested that some acute inpatient hospitalizations among disabled elderly can be prevented with interventions in both the home and a nursing facility settings (Walsh, Wiener et al. 2012). For example, ensuring properly hydration, mitigating fall risks, managing medications, and avoiding pressure injuries (Ouslander and Berenson 2011, Ouslander and Maslow 2012). Past literature comparing HCBS and nursing home populations found a lower risk of hospitalization among nursing home residents, suggesting that the nursing homes might have practices in place that can potentially prevent hospitalizations, something not necessarily as present for HCBS users (Wysocki, Kane et al. 2014). A care attendant spending less than four hours a day with a person might spend the majority of his or her time supporting a person's activities of daily living, and not have sufficient time in the home to detect subtle changes in health or function that might precipitate an acute need. Further research is needed to determine what personal attendants actually do in the home when they are there for a have longer amount of time.

The higher rate of hospitalization among people using HCBS compared to those who do not use HCS may be a result of that fact that people who applied to receive HCBS but were deemed ineligible have developed better means of managing their disabilities and managing these risks in the absence of Medicaid financed HCBS. These people may rely more on unpaid care giving. How these risks for hospitalization are being managed by both populations is not known and should be researched further.

We conducted a secondary analysis excluding people not using HCBS (see Appendix A). This model still shows the same relationship between level of PAS and hospitalization, and the same patterns with respect to adult day care and home delivered meals. Finally, the results are not sensitive to the choice of estimators. Re-analysis using Generalized Estimating Equations (See Appendix B), finds the same pattern of results.

3.5.1 Limitations and Future Research

The primary limitation of this study is that it is an observational cross sectional study thus, it does not draw a clear causal pathway from service use to the risk of hospitalization. This research can only identify groups of people using specific services and their associated risk for experiencing a hospitalization. The participants were not randomized and certain constellations of HCBS had exceptionally small sample sizes, thus being under powered.

We also did not look at the total array of services offered to each client. We did not have information in our data to see specific services. We did not have any way of measuring or examining the types of home modifications people received. We also were not able to see a person's use of transportation services (i.e. did a person use subsidized public transit, did a person use a service like access, did a person have their attendant aid provide transportation). These are

very important services that affect a person's wellbeing and risk of hospitalization and we did not account for them in our analysis. We also did not observe tasks the personal care attendant was doing. In some instances, the personal care attendant might be cooking and in other instances a person may just be getting a meal to give the attendant more time to focus on other things. Ideally for a future study, we could have greater insight into services a person was receiving and what the personal care aid was doing beyond just what was being is billed.

Another limitation is that we did not look at emergency department visits nor did we classify hospitalizations as potentially avoidable or ambulatory care sensitive. Future studies may profitably examine whether certain hospitalizations are more responsive to HCBS.

3.5.2 Conclusions

We found that the type and amount of PAS is associated with risk of acute hospitalization. This suggests that HCBS users with relatively low levels of PAS may benefit from additional units of service through reduction of hospitalization rates. As policy makers continue to plan for the needs of an aging society, these findings suggest that HCBS may provide important benefits beyond maintaining independence and dignity. Further research is still needed to understand how the type and amount of HCBS affects nursing home placement, mortality, and quality of life.

3.6 Tables and Figure

Table 4: Characteristics of Elderly HCBS Users and Non-Users

Variable	HCBS Users [a] (n = 95,464) Mean or % (SD)		Non-Users [b] (n = 57,801) Mean or % (SD)		Chi^2 or t-test
Average person quarters observed	6.13	(2.95)	6.39	(3.03)	p<0.001
Average Age	79.3	(9.30)	75.8	(8.6)	p<0.001
65-70	17%		29%		p<0.001
70-75	17%		23%		p<0.001
75-80	19%		19%		p<0.001
80-85	18%		13%		p<0.001
85+	30%		15%		p<0.001
Disability Indicators					
Continence	4.38	(3.4)	2.3	(2.9)	p<0.001
ADL	6.82	(2.3)	3.78	(3)	p<0.001
IADL	9.77	(3.2)	7.15	(3)	p<0.001
Count of Chronic Conditions	4.07	(2.6)	3.3	(2.5)	p<0.001
Alzheimer's Diagnosis	28%		16%		p<0.001
Gender					

Table 4 Continued

Men	27%	31%	p<0.001
Women	73%	69%	p<0.001
Location			
Rural	13%	16%	p<0.001
Urban	87%	84%	p<0.001
Race			
White	54%	59%	p<0.001
Black	28%	19%	p<0.001
Hispanic	1%	2%	p = 0.021
Asian	10%	9%	p<0.001
Other	7%	10%	p<0.001

Notes:

a. The total number of unique individuals enrolled in HCBS observed in this study is 15,627
b. The total number of unique individuals who applied but were not granted Medicaid funded HCBS observed in this study is 9,094

Table 5: Number of Person Months in Each Constellation of HCBS

	PAS Only		PAS and Adult Day		PAS and Meals		PAS and Adult Day and Meals	
Level of PAS	n	%	n	%	n	%	n	%
1-4 Hours	31,911	18.77%	7,404	4.36%	14,160	8.33%	617	0.36%
4-8 Hours	27,319	16%	2,772	1.63%	7,282	4.28%	302	0.18%
>8 Hours	8,370	4.92%	233	0.14%	1,843	1.08%	77	0.05%

Table 6: Logistic Regression Examining Risk of Hospitalization used to Produce Predicted Probabilities

Odds of Experiencing a Hospitalization	Odds Ratio	95% Confidence Interval	
Gender (Male)			
Female	0.864	0.833	0.896
Race (White)			
Black, Non-Hispanic	1.261	1.208	1.317
Hispanic, White	0.964	0.844	1.100
Asian American	0.637	0.590	0.687
Other Race	0.852	0.798	0.909
Geographic (Urban)			
Rural	0.959	0.912	1.008
Age Category (65-70)			
70<-75	0.973	0.926	1.022
75<-80	0.938	0.891	0.987
80<-85	0.948	0.898	0.999
85+	1.012	0.963	1.063
CHC Phase (Southwestern PAS)			
South Eastern PA	0.707	0.670	0.746
Northern and Central PA	0.981	0.930	1.035
Level of Disability			
Continence	1.016	1.010	1.022
ADL	1.044	1.035	1.053
IADL	1.061	1.050	1.073
Alzheimer's or Related Dementia	0.898	0.861	0.936
Living Situation (Lives Alone)			
Lives with an Adult Child	0.979	0.935	1.026
Lives Other Person	1.032	0.979	1.088
Lives with Spouse	0.832	0.786	0.880
Lives with Other Family	0.988	0.936	1.042
Time Observed in the Data	1.015	1.009	1.021
Constellations of Care (Non-HCBS)			

Table 6 Continued

Low PAS			
Only PAS	1.234	1.178	1.293
PAS and Adult Day Care	0.616	0.557	0.682
PAS and Delivered Meals	1.355	1.279	1.435
PAS, Adult Day Care, and Delivered Meals	0.858	0.659	1.116
Medium PAS			
Only PAS	0.870	0.824	0.917
PAS and Adult Day Care	0.694	0.602	0.799
PAS and Delivered Meals	0.911	0.841	0.987
PAS, Adult Day Care, and Delivered Meals	0.964	0.685	1.357
High PAS			
Only PAS	0.791	0.728	0.859
PAS and Adult Day Care	0.813	0.541	1.223
PAS and Delivered Meals	0.871	0.754	1.006
PAS, Adult Day Care, and Delivered Meals	1.184	0.617	2.272
Count of Chronic Conditions (0-1 diseases)			
2-3	1.136	1.076	1.199
4-5	1.638	1.553	1.726
6+	3.379	3.216	3.550
Constant	0.058	0.053	0.064

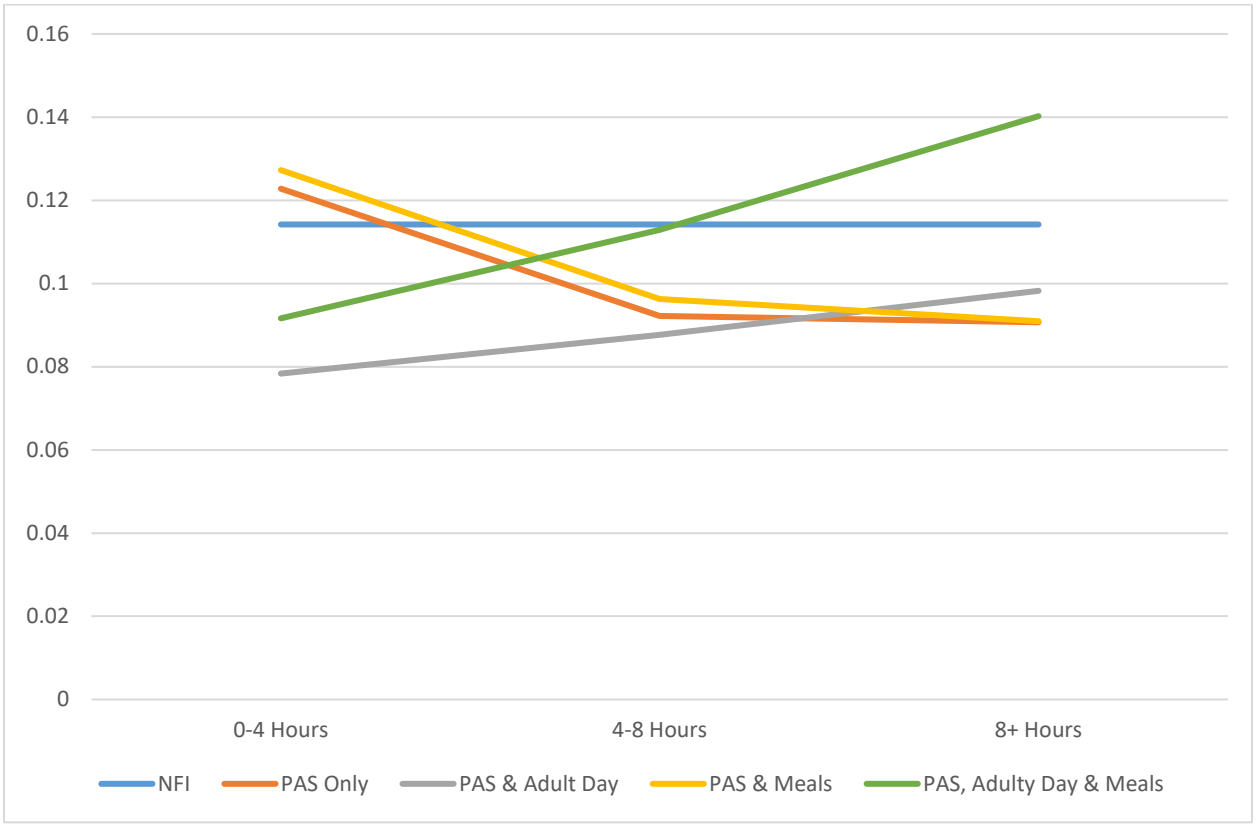

Figure 1: Graphical Representation of Each Constellation's Probability of Experiencing a Hospitalization

4.0 Risk of Hospitalization Associated with Use of Consumer Directed PAS

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4.1 Abstract

Background

Elderly people with disabilities often use attendant care, also known as Personal Assistive Services (PAS), to live independently and support their activities of daily living. Often the aids who assist elderly people are hired by an agency that is then contracted by the state Medicaid authority to provide assistance to the elderly and disabled. This system gives the recipient of the PAS care relatively little control over their attendant care. One alternative means of administering attendant care is where, instead of contracting with a home care agency, the state gives the Medicaid recipient a monthly allowance and the recipient is charged with administering his or her own care. This system, also referred to as consumer directed attendant care, gives a Medicaid recipient more autonomy in hiring, training, and managing his or her own in home care. Consumer directed attendant care can potentially augment family care giving that may already be taking place. There are some hypothesized risks that can potentially arise from using consumer directed attendant care, most notably that the Medicaid recipient may not be able to train and manage an in home aid as well as a professional agency can, potentially leading to health hazards. This paper looks to see if people receiving consumer directed attendant care are at a higher risk for experiencing a hospitalization compared to people receiving agency directed attendant care.

Methods

The data for this study came from Pennsylvania Medicaid claims, enrollment files, and enrollee evaluations, and hospitalization records from Medicare and Medicaid. This analysis compared the risk of hospitalization of people using consumer directed care to the risk of hospitalization of people using agency directed care using an OLS regression and a two stage least square regression. The two stage least square equation used the percentage of people in a county

using consumer directed care as a proxy for the effect a peer group would have on a person's decision to use consumer directed attendant care. We then ran an F test to validate the instrument. After the instrument was derived, it was used in the second stage of the regression to examine how use of risk of consumer directed care effects risk of hospitalization.

Results

The OLS regression found people using consumer directed care faced a 0.0003 lower risk of hospitalization ($p<0.001$) compared to those using agency directed care. Using the two stage least square model, people using consumer directed care did not have a statistically significant difference in risk for hospitalization compared to people using agency directed PAS ($p = 0.976$).

Conclusions

In both models, the risk of hospitalization was practically no different for people using consumer directed care compared to people using agency directed care. This does not conflict with previous literature that suggests that the people who receive consumer directed PAS are more satisfied with their care because care giving is more than just preventing hospitalizations. This study does suggest a number of important future research topics, like how care giving might be administered differently under each model and who might be excluded or less likely to use agency directed care who might benefit from using consumer directed care.

4.2 Background

As people grow older, they may need more assistance with day to day activities. Much of this care will be support with activities of daily living, completing tasks like eating, meal preparation, cleaning, walking, toileting, shopping, housework, etc. Some older adults with high levels of disability may require the type and amount of care traditionally administered in a nursing facility. However, most older people would prefer to live independently as they age and get support and assistance from family members, friends, neighbors, and potentially paid care givers. Home care has been shown prevent or delay admission to a nursing home (Vertrees, Manton et al. 1989, Degenholtz, Kane et al. 1997, Kane, Kane et al. 1998, Duckett and Guy 2000, Assistant Secretary for Planning and Evaluation 2016). Often a care attendant can compensate for a permanent loss of function created by a disability (Verbrugge and Jette 1994).

Medicaid is the primary payer for long term services and supports (LTSS) (Reaves and Musumeci 2015, Dumont, Oh et al. 2018). The aging of the population will lead to increasing cost of LTSS and the growing role of Medicaid will continue to place pressure on public budgets (Kaye, LaPlante et al. 2009). One of the proposed strategies for providing high quality care while controlling costs is to use consumer directed attendant care or personal assistive services (PAS) (Doty, Kasper et al. 1996, Doty 2000, Benjamin 2001). Consumer directed PAS is a program where the state Medicaid agency overseeing in home care for elderly people gives an elderly Medicaid recipient in need of a personal care attendant an alloted amount of money each month which the individual can use to hire and pay a care giver of their choosing. The state pays the salary of the care giver but the elderly individual is charged with hiring, training, and managing the care giver (Glover and Harman 2000, Osterman 2017). These programs reduce cost by lowering the overhead associated with the traditional agency model.

Consumer direction represents a dramatic shift in the way Medicaid HCBS is delivered. The traditional agency model was used by Mediciad HCBS programs for the aged (Tilly and Wiener 2001). This system gave the Medicaid recipient relatively little control over his or her care. Consumer directed care became popular in state Medicaid programs in the 1980's and 1990's for a number of reasons. First, it offered lower administrative costs. Second, it gives recipients more control over his or her care. Third, in most programs, recipients have the ability to purcahse other care related items. Finally, it makes it possible to tap into an expanded pool of long-term care workers (Doty, Kasper et al. 1996, Doty 2000, Benjamin 2001, Doty, Mahoney et al. 2007, Lombe, Inoue et al. 2016). The most common form of care for aged individuals comes from family support (Stone, Cafferata et al. 1987, Doty 2000, Parker, Horowitz et al. 2015, Schulz, Eden et al. 2016). In certain cases, the a person using consumer directed care could use the Medicaid funds to pay a family care giver and thus enhance the family care giving already taking place (Simon-Rusinowitz, Mahoney et al. 1998, Simon-Rusinowitz, Mahoney et al. 2005). Consumer directed care gives the Medicaid recipient more flexability to craft his or her care to meet his or her own unique needs. Many times this means enhancing the family care giving already taking place.

There are some potential drawbacks to consumer directed care. The first and foremost is that the aged and disabled Medicaid recipients may not be capable of managing their caregiver, even if that care giver is a family member. While care from an agency may have less flexability, the care givers from agencies may have more training and may be more prepared to address common ailments that affect aged and disabled individuals. Agency directed care can also potentially be more reliable because the agency is responsible to make sure that every shift is covered.

Previous literature on consumer directed care has focused on the feasiblity of implementing a consumer directed program and preferences associated with people using consumer directed care (Doty 1986, Doty 2000, Simon-Rusinowitz, Mahoney et al. 2005, Doty, Mahoney et al. 2007). Some research points to opportunities for improved quality of care at a lower cost (Buntin, Damberg et al. 2006). There has only been one study of broad health outcomes associated use of consumer directed care (Kim, Fox et al. 2006). This study found that generally improved health was associated with use of consumer directed care, but concluded that more research needed to be conducted on this topic.

This study examines whether users of consumer directed PAS are more or less likely to experiece an acute care inpatient hospitalization when compared to Medicaid recipients who receive agency directed PAS. Looking at the risk of experiencing a hospitalization is important in understanding the future of consumer directed PAS. First, a higher risk of hospital admission is a sign of poor quality of care. Hospital admissions are also very costly for the enitre healthcare system and will often lead to a nursing home placement (James Goodwin 2011). If consumer directed PAS is to be a piece of the LTSS solution for aging Americans, preventing hospitalizations is an important prioirty in supporting people as they live independently. Understanding how use of consumer directed care is associated with hospitalization risk is important in crafting these policies for the current and future generations of senior citizens. This paper seeks to understand how risk of hospitalization differs for people using consumer directed care.

4.3 Methods

This study is a pooled cross sectional analysis examining how using consumer directed PAS is associated with risk of experiencing an acute inpatient hospitalization among elderly and disabled Pennsylvanians from June 2014 to December 2016. This section discusses the data and the analytic methods used to examine the association between the type of PAS a person uses and their risk of experiencing an acute inpatient hospital admission. The first section describes the data used for this analysis. The second section describes the analytic methods.

4.3.1 Data

The data for this study came from five different data sources: 1) Medicaid enrollment and demographic information for each enrollee, 2) Medicaid service use claims describing the type of PAS a person used, 3) hospitalization data from both Medicaid and Medicare 4) disability related data from the assessment to deem a person's eligibility to receive long term services and supports and 5) a list of the chronic disease diagnoses for each Medicaid recipient. The unit of observation for our study was the person quarter. We used the person quarter as a unit of analysis because it was granular enough to capture changes in service plans. The person quarter had also been used in previous evaluations of HCBS and hospitalization (Wysocki, Kane et al. 2014). The variable of interest was the type of PAS, agency or consumer directed, the person used.

The outcome of interest was risk for experiencing an acute inpatient hospital admission. Data on this came both from Medicaid and Medicare claims. We excluded admissions to psychiatric facilities and admissions to long term care hospitals, focusing only on acute care hospital admissions. These admissions are systematically different than acute care inpatient and

they are not the types of hospital admissions that can generally be prevented through improved HCBS care (Walsh, Wiener et al. 2012). The outcome variable was a binary variable indicating whether or not a person had experienced at least one hospitalization during the quarter in which they were observed.

The first covariate entered into this model described a person's demographic information (race, gender, ethnicity, age, and county of residence) and when their enrollment in the Medicaid waiver program began and ended. Each person was identified by a random identifier that stayed with them for the entirety of their Medicaid enrollment. This identifier connected a person's enrollment information to all of the other data used in this study. In order for a person quarter to be included in our data the person needed to be alive and enrolled in the 1915(c) aging waiver for the entirety of the quarter. If a person was unenrolled, went into a nursing facility for an extended period of time, or died during the person quarter, that quarter was not entered into our analysis. While people can be enrolled in the aging waiver at age 60, we limited the people in our study to people who were dually-eligible for Medicaid and Medicare, so the youngest people in this study were 65. Enrollees older than 65 who had previously been enrolled in another disability related waiver before being enrolled in the aging waiver were not included in the study.

The data concerning the type of PAS a person used came from Medicaid service use claims. People enrolled in the Pennsylvania Medicaid aging waiver had the option of using a number of different services in addition to attendant care. For this analysis, we only looked at people who used agency or consumer directed PAS. If a person was enrolled in the waiver but did not use any PAS, he or she was not counted in our data. People who used both kinds of PAS were also excluded from our primary analysis. Fewer than 3% of the people enrolled in the 1915(c) waiver used both type of PAS.

The criteria to determine if a person was eligible to receive 1915(c) waiver services under Medicaid was collected through an evaluation administered by the local area agency on aging in coordination with the Pennsylvania Department of Human Services. This evaluation collected information such as the person's disability level for each basic Activities of Daily Living (ADL) and Instrumental Activity of Daily Living (ADL), a diagnosis of Alzheimer's Disease or a related Dementia, and living arrangement (i.e. does the person live alone, with a spouse, with an adult child, etc.). All of this information was included in our model.

Disability was measured using information on a person's basic activities of daily living, instrumental activities of daily living, and level of incontinence. In the evaluations to see if a person was eligible to receive HCBS funded by Pennsylvania Medicaid, a person was classified as totally independent, requiring assistance, or totally dependent for fourteen different basic or instrumental activities of daily living. These activities included eating, toileting, transferring, dressing, bathing, walking in doors, walking outdoors, housework, managing money, using a telephone, preparing meals, shopping, bladder control, bowel control, and if necessary, managing an ostomy bag. Limitations for each activity were given a specific weight which was then combined with other activities and converted into a ten point scale (Finch, Kane et al. 1995, Barnato, Albert et al. 2011). Separate scales measured limitations regarding ADLs, measured limitations regarding IADLs, and incontinence. In each scale a zero represented total independence and a ten represented total dependence. We also included a binary indicator to denote if a person had been diagnosed with Alzheimer's Disease or a related dementia.

We used a series of binary variables to indicate a person's living arrangement. The possible living situations a person could have had were living alone, living with an adult child, living with another family member, living with another person, or living with a spouse. The majority of people

who were married indicated that they were living with a spouse, but if a person was married and he or she indicated a different living situation then we counted that person as the living situation he or she identified, not as living with their spouse.

For this study we used information on the number of diagnosed chronic condition each of each person. This information was converted into a count of chronic conditions to indicate each person's overall disease burden.

4.3.2 Analysis

This paper had two major analyses. The first analysis was composed of descriptive statistics and the second analysis used a set of econometric techniques to model the association between risk of hospital admission and type of PAS used. The first analysis is a depiction of the demographic characteristics, information on living situation, count of chronic diseases, and average disability levels. This analysis sought to gain an overall picture of the different people using each type and level of PAS.

The second analysis used a linear probability model and a two-stage least squares regression model to examine the associated between consumer directed care and risk of hospitalization. The naïve linear probability model did not account for the possible endogeneity due to selection bias in a person's choice to use consumer directed care. This regression used robust standard errors, clustering on the person (Freedman 2006), to account for people having repeated observations. In the two stage least square regression model, the percentage of people (excluding the given person) in a specific county using consumer direction was used as an instrumental variable for the given person's use of consumer directed PAS. To support the validity of this approach, an F-test on the first stage model was used to make sure that the instrument was

not weak. Using the instrumented treatment variable, we estimated the second stage of the regression model to test the main study hypothesis.

The rationale for the selected instrument is that percentage of people in a county using consumer directed PAS is a measure of how widespread that model is in the community. We hypothesize that community level use of consumer direction will influence individual's use. Although this model is not traditional, consumers have generally positive experience with it (Doty, Mahoney et al. 2007). This approach has been used extensively in studies where the effect of a person's peers on the individual's choice is used as an instrumental variable to correct for the endogeneity present when different treatments are not randomly assigned (Hausman 1996, Heckman and Vytlacil 1999).

Other covariates in the model were race, gender, age, rurality, location within the state of Pennsylvania, the person's level of continence, the person's ADL and IADL levels, the living situation of the individual (whether the person lived with a child, a spouse, another family member, another person, or alone), a categorical variable describing the count of chronic diseases a person had (0-1, 2-3, 4-5, 6+) and a count of the number of quarters the person had been observed in our data. The count of the number of quarters the person had been observed in the data was to account for any time related factors that would not be captured by age.

4.4 Results

The total number of person quarters observed using agency directed PAS was 82,610 and the total number of person quarters observed using consumer directed was PAS 17,393. Of people using agency directed care, 72% were women and 27% were men. Of people using consumer

directed care, 75% were women and 25% were men. With regards to rurality, 20% of people using consumer directed care lived in rural areas compared to only 11% of people using agency directed care. With regards to race, 60% of people using agency directed care were white, 23% were black, 1% were Hispanic, 10% were Asian, and 7% had a race listed as other. By contrast, among people using agency directed care, 49% of people were white, 36% were black, 2% were Hispanic, 6% were Asian, and 8% had a race listed as other. Of people using agency directed PAS, 27% had a diagnosis of Alzheimer's Disease or a related Dementia compared to 29% of people using consumer directed care. The average ADL score for people using agency directed care was 6.70 out of 10. The average ADL score for people using consumer directed care was 7.01 out of 10. The average IADL score for people using agency directed care was 6.11 out of 10. The average IADL score for people using consumer directed care was 6.48 out of 10. The average weighted score measuring a person's level of continence for people using agency directed care was 4.30 out of 10. The average weighted score measuring a person's level of continence for people using consumer directed care was 4.43 out of 10. (see table 7).

In the naïve linear probability model, people using consumer directed care experienced a 0.0003% ($p<0.001$) lower chance of experiencing a hospitalization compared to people using agency directed PAS (see table 8). The IV results show that the risk of hospitalization associated with use of consumer directed PAS is not statistically significantly different than people using agency directed PAS ($p=0.928$). The F-statistic of the first stage regression model was 3955.78. The R^2 value of the first stage was 0.1720, the adjusted R^2 was 0.1718, and the partial R^2 was 0.0416. The F-test was statistically significant meaning we could reject the null hypothesis that the instrument was weak ($p<0.001$). The results of the first stage regression can be found in Appendix A.

In the IV model (see Table 7), women faced a 1.1% lower risk of hospitalization ($p<0.001$) when compared to men and Asian Americans faced a 3.2% lower risk of hospitalization ($p<0.001$) when compared to white people. African Americans faced a 3.5% increased risk of hospitalization ($p<0.001$) compared to white people. People diagnosed with Alzheimer's Disease or a related Dementia were 2.1% less likely to experience a hospitalization compared to people not diagnosed with Alzheimer's Disease or a Related Dementia ($p<0.001$). A 10% increase in a person's incontinence, ADL level, and IADL level was all associated with a less than 1% increase of risk of hospitalization ($p<0.01$). People who lived in Southeastern PA faced a 5.0% lower risk of hospitalization compared to people living in Western PA ($p<0.001$). People living with another person who was not related to them faced a 3.0% increased risk of hospitalization compared to people living alone ($p<0.001$). People living with a spouse faced a 2.1% reduction in risk of hospitalization when compared to people living alone ($p<0.001$). People living with an adult child or another family member faced a 1.1% and 1.3% lower risk of hospitalization compared to people who lived alone ($p<0.01$). People using consumer direct PAS did not have a statistically significantly different risk of hospitalization compared to people using agency directed PAS.

We used a two stage least square model to examine the association between risk for mortality and use of consumer directed PAS. We found that people using consumer directed PAS did not face a statistically significantly different risk of mortality when compared to people using agency directed PAS ($p = 0.393$). These results are listed in Appendix B.

4.5 Discussion

This study found no difference in the probability of hospitalization when comparing people using consumer directed personal assistive services compared to agency delivered care. Although the naïve linear probability model found that risk of hospitalization was slightly negatively correlated with use of consumer direction, the coefficient was so small that the reduction in risk was almost negligible. Given that care giving is a complex duty and is focused on more than just reducing risk of hospitalization, these findings are reassuring that care delivered by family members or unrelated individuals who are not under the auspices of a home care agency does not appear to be associated with increased risk of hospitalization.

Previous studies of consumer direction have found that people who use this model are more satisfied with their care than people who use agency delivered care (Simon-Rusinowitz, Mahoney et al. 2005, Doty, Mahoney et al. 2010, Lombe, Inoue et al. 2016). However, those previous studies did not examine the crucial question of whether consumers were exposed to increased risk for hospital admission. Critics have asserted that care delivered outside of an agency model is not supervised by professionals and that caregivers may be insufficiently trained. On the other hand, proponents of consumer direction argue that the client knows best how they should be cared for, and that the close relationship (often familial) leads to greater trust and also a higher level of awareness of physiological or cognitive changes that might require intervention. Our findings do not address the skill or quality of the caregivers in either model, however, the equivalence of the outcomes suggests that people who prefer to employ and manage their own care giver are not necessarily taking an elevated risk of hospitalization.

One of the important qualities of consumer directed PAS is that it taps into a different pool of potential home care workers and gives consumers a greater deal of choice in how they manage

their in personal care attendant (Doty, Mahoney et al. 2010, Lombe, Inoue et al. 2016). Some elderly people may feel uncomfortable having a person they do not know come into their homes but are more comfortable receiving help from a family member. Some people, especially those in rural areas, may have very limited access to home care but may have an extensive social network they can rely upon. These elderly individuals may otherwise face limited access if they were restricted to the agency model.

There is the potential risk that although the hospitalization risk may be similar, people in the consumer directed model may be going to the hospital for different or more severe conditions. We therefore ran a secondary analysis of mortality, controlling for the same factors as the hospitalization model. The hypothesis of this model was that people in the consumer directed model are just going to the hospital later once a problem grows to be too unmanageable. This analysis found that for each person-quarter, people using consumer directed PAS had a similar likelihood of dying in subsequent quarter ($p = .393$; available on request). Thus, suggests that the similar rate of hospitalization is not masking underlying differences in severity. Future research should examine a longer follow-up period and include other outcomes such as hospital readmission and nursing home placement.

Previous studies have found that the majority of care giving for elderly people comes from family and informal care givers (Stone, Cafferata et al. 1987, Doty 2000, Parker, Horowitz et al. 2015, Schulz, Eden et al. 2016). One of the precieved benefits of consumer direction is its ability to tap into and possibly enhance a system of family care giving already present (Simon-Rusinowitz, Mahoney et al. 1998, Simon-Rusinowitz, Mahoney et al. 2005). If an elderly person is employing a family member to be a care giver, that family member may be able to reduce the number of hours he or she works in the formal economy or quit his or her job all together. If this

were to happen, the number of both paid and unpaid hours of care giving very well might increase. The observation that people using consumer directed care could potentially be receiving more hours of care (some paid and some unpaid) but experience the same risk of hospitalization implies that consumer directed care may be less efficient on a per hour basis with respect to this outcome. However, having a care giver present for more hours may have other benefits such as improving quality of life (Buntin, Damberg et al. 2006). How the total hours of family care giving changes depending on a person's use of consumer directed care should be studied further.

Future research should examine costs associated with agency and consumer directed care, including cost effectiveness analysis. While more research on the costs of HCBS needs to be done, consumer directed care apparently costs less than agency directed care (Buntin, Damberg et al. 2006). Consumer directed care in Pennsylvania during the observation period of this study ranged from $13.64 per hour and $16.04 per hour depending where the recipient lived in Pennsylvania. On the other hand, agency directed care in Pennsylvania during the observation period ranged from $17.52 per hour and $19.52 per hour depending where the recipient lived in Pennsylvania. If consumer directed care can be delivered at a lower price while not increasing a person's risk of hospitalization or mortality, then it very well could serve as a mechanism for providing high quality care for elderly people that does not overburden public funds. Before this assertion can made however, more research needs to be done on the quality of consumer directed care, the total number of hours used in consumer directed care, and if consumer directed care actually is more cost effective than agency directed care.

Future research on this topic should also focus on other outcomes associated with consumer directed care. Outcomes like nursing home placement are very important in fully understanding the risks, costs, and benefits of using consumer directed care. By studying other outcomes, a more

comprehensive picture can be constructed about the benefits of consumer directed and agency directed care. Risk for hospitalization, while an important outcome that carries strong implications, is not the only important health related outcome. Since consumer directed care can utilize family care giving already taking place, outcomes associated not only with the recipient, but the care giver are also an important area of future study. Care giving can be a straining activity, especially when done for family. While augmenting family care giving may be beneficial in some areas, it might potentially create risks for the care giver that will be experienced later in the care giver's life. This paper is one of the first papers to examine outcomes associated with consumer directed care and hopefully serve as an impetus for other outcomes related research concerning attendant care.

4.5.1 Limitations

One limitation of this study is that we are not able to observe the relationship between the caregiver and care receivers. Nor can we observe the quality of care delivered in each model. Although previous research showed an association between other home and community based services, like home delivered meals and adult day care, and hospitalization risk, these services are strongly associated with disability level and other factors included in this analysis. Thus, although the model may be under-adjusted, it is not likely to be mis-specified. There is no evidence to suggest that use of those services is associated with preference for consumer direction, thus excluding these factors should not bias our findings. Finally, even though the use of IV models permits causal inferences, we do not advance a causal pathway for how consumer directed model of care and agency directed model of care prevent adverse health outcomes, and do not draw any conclusions about the underlying mechanism.

4.5.2 Conclusion

Consumer directed care has the potential to meet each end of the triple aim. It can enhance family care giving and provide an option for attendant care for some people who are not comfortable with or do not have access to agency directed care. This study found that people who rely on consumer directed care are not at increased risk of hospitalization. Future research should examine other important outcomes.

4.6 Tables

Table 7: Demographic Information

	Agency Directed PAS [a] (n = 82,610)		Consumer Directed PAS [b] (n = 17,393)		
	Mean or % (SD)		Mean or % (SD)		Chi^2 or t-test
Average person quarters observed	6.85	(2.98)	6.83	(2.91)	p = 0.50
Average Age	79.8	(8.54)	78.09	(8.82)	p<0.001
65-70	16%		24%		
70-75	17%		19%		
75-80	19%		16%		
80-85	19%		17%		
85+	30%		25%		
Gender					
Men	27%		25%		p<0.001
Women	72%		75%		p<0.001
Location					
Urban	89%		80%		p<0.001
Rural	11%		20%		p<0.001
Race					
White	60%		49%		p<0.001
Black	23%		36%		p<0.001
Hispanic	1%		2%		p<0.001
Asian	10%		6%		p<0.001

Table 7 Continued

Other	7%		8%		p<0.001
Disability Level					
Continence	4.3	(3.40)	4.43	(3.49)	p<0.001
ADL	6.7	(2.36)	7.01	(2.20)	p<0.001
IADL	6.11	(2.03)	6.48	(1.98)	p<0.001
Alzheimer's Disease or Related Dementia	27%		29%		p<0.001
Count of Chronic Conditions	1.596	(1.10)	1.784	(1.01)	p<0.001
Living Situation					
Lives Alone	45%		26%		p<0.001
Lives with Adult Child	20%		37%		p<0.001
Lives with Other Family	11%		21%		p<0.001
Lives with Spouse	16%		6%		p<0.001
Lives with other Person	8%		10%		p<0.001
Location within Pennsylvania					
Southwestern PA	9%		10%		p<0.001
Southeastern PA	65%		43%		p<0.001

Table 7 Continued

North and Central PA	26%	47%	p<0.001

Notes:

a. The total number of people enrolled in agency directed PAS was 12,068

b. The total number of people enrolled in consumer directed PAS was 2,547

Table 8: Regression Results Examining Risk of Hospitalization Associated with Use of Consumer Directed Care

	Instrumental Variable Model			Linear Probability Model		
Variable	Coeff.	Std. Err.	P>z	Coeff.	Std. Err.	P>z
Use of Consumer Directed PAS	-0.001	0.015	0.928	-2.94E-06	6.44E-07	<0.001
Gender (Male)						
Female	-0.011	0.003	<0.001	-0.012	0.003	<0.001
Race (White)						
African American	0.035	0.004	<0.001	0.037	0.003	<0.001
Hispanic	-0.003	0.010	0.737	-0.004	0.010	0.694
Asian American	-0.032	0.004	<0.001	-0.032	0.003	<0.001
Other Race	-0.011	0.005	0.021	-0.011	0.005	0.015
Geography (Urban)						
Rural	-0.001	0.004	0.722	-0.002	0.004	0.67
Age (65-70)						
70-75	-0.003	0.004	0.437	-0.001	0.004	0.826
75-80	-0.007	0.004	0.063	-0.006	0.004	0.092
80-85	-0.006	0.004	0.109	-0.006	0.004	0.12
85+	0.000	0.004	0.988	0.001	0.004	0.798
Location in Pennsylvania (Southwestern PA)						

Table 8 Continued

Southeastern PA	-0.050	0.004	<0.001	-0.039	0.005	<0.001
Northern and Central PA	-0.005	0.005	0.344	-0.004	0.005	0.431
Disability Level						
Alzheimer's or Related Dementia	-0.021	0.003	<0.001	-0.022	0.003	<0.001
Continence (0-10)	0.001	0.000	0.004	0.001	0.000	0.004
ADL (0-10)	0.002	0.001	<0.001	0.003	0.001	<0.001
IADL (0-10)	0.009	0.001	<0.001	0.009	0.001	<0.001
Living Situation (Lives Alone)						
Lives with an Adult Child	-0.011	0.004	0.009	-0.011	0.003	0.001
Lives with Another Person	0.030	0.005	<0.001	0.029	0.005	<0.001
Lives with Spouse	-0.021	0.004	<0.001	-0.022	0.003	<0.001
Lives with other Family	-0.013	0.004	0.003	-0.014	0.004	<0.001
Time Observed in our Data	0.001	0.000	0.128	0.001	0.000	0.051
Count of Chronic Conditions (0-1)						
(2-3)	-0.001	0.004	0.883	0.000	0.003	0.98
(4-5)	0.034	0.004	<0.001	0.034	0.003	<0.001
(6+)	0.138	0.004	<0.001	0.138	0.004	<0.001
Constant	0.059	0.007	<0.001	0.0617	0.0073	<0.001

Appendix A Chapter 3

Below are alternative specifications for the model shown in Table 3.

Appendix A (Table 9) presents is a logistic regression model that uses robust standard errors to examine the risk of hospitalization associated with different constellations of HCBS. This model however does not include people who had applied to receive Medicaid funded HCBS and were deemed ineligible. People receiving low levels of PAS were the reference category when evaluating risk of hospitalization.

Appendix B (Table 10) presents the predicted probabilities for this model.

Appendix C (Table 11) presents a Generalized Estimating Equation to evaluate the risk of hospitalization associated with different constellations of HCBS. This model does include community dwelling elderly people who are not receiving Medicaid funded HCBS.

Table 9: Logistic Regression Model Examining Association between HCBS Constellation and Hospitalization, Excluding Community Dwelling Elderly People with no HCBS

	Odds Ratio	Std. Err.	95% Confidence Interval	
Gender (Male)				
Female	0.916	0.021	0.877	0.958
Race (White)				
Black, Non-Hispanic	1.272	0.032	1.210	1.337
Hispanic, White	0.948	0.078	0.806	1.114
Asian American	0.682	0.031	0.624	0.745
Other Race	0.867	0.037	0.798	0.943
Geographic (Urban)				
Rural	0.971	0.031	0.912	1.033
Age Category (65-70)				
70<-75	1.001	0.032	0.940	1.066
75<-80	0.969	0.032	0.909	1.033
80<-85	0.987	0.033	0.926	1.053
85+	1.062	0.032	1.000	1.127
CHC Phase (Southwestern PAS)				
South Eastern PA	0.714	0.024	0.669	0.762
Northern and Central PA	1.011	0.035	0.945	1.082
Level of Disability				
Continence	1.016	0.003	1.009	1.022
ADL	1.038	0.006	1.027	1.050
IADL	1.092	0.008	1.078	1.107

Table 9 Continued

Alzheimer's or Related Dementia	0.881	0.022	0.839	0.924
Living Situation (Lives Alone)				
Lives with an Adult Child	0.925	0.025	0.877	0.976
Lives Other Person	1.207	0.042	1.127	1.293
Lives with Spouse	0.809	0.027	0.758	0.864
Lives with Other Family	0.917	0.030	0.860	0.978
Time Observed in the Data	1.014	0.003	1.007	1.020
Constellations of Care (Only uses Low PAS)				
Low PAS				
PAS and Adult Day Care	0.526	0.026	0.477	0.579
PAS and Delivered Meals	1.112	0.032	1.051	1.178
PAS, Adult Day Care, and Delivered Meals	0.697	0.091	0.541	0.900
Medium PAS				
Only PAS	0.702	0.019	0.666	0.739
PAS and Adult Day Care	0.577	0.040	0.504	0.662
PAS and Delivered Meals	0.749	0.030	0.693	0.809
PAS, Adult Day Care, and Delivered Meals	0.809	0.137	0.581	1.126
High PAS				
Only PAS	0.616	0.026	0.568	0.669
PAS and Adult Day Care	0.631	0.128	0.423	0.941

Table 9 Continued

PAS and Delivered Meals	0.687	0.050	0.597	0.792
PAS, Adult Day Care, and Delivered Meals	0.849	0.281	0.444	1.623
Count of Chronic Conditions (0-1 diseases)				
2-3	0.993	0.033	0.930	1.061
4-5	1.416	0.047	1.327	1.511
6+	2.947	0.090	2.776	3.129
Constant	0.064	0.004	0.057	0.073

Table 10: Predicted Probabilty of Hospitalization by HCBS Constellation, Excluding Community Dwelling Elderly People with no HCBS

	Predicted Risk of Hospitalization	Std. Err.	95% Confidence Interval	
Constellations with Low PAS				
Only PAS	0.152	0.002	0.148	0.157
PAS and Adult Day Care	0.086	0.004	0.079	0.094
PAS and Delivered Meals	0.167	0.003	0.160	0.173
PAS, Adult Day Care, and Delivered Meals	0.111	0.013	0.086	0.137
Constellations with Medium PAS				
Only PAS	0.112	0.002	0.108	0.116
PAS and Adult Day Care	0.094	0.006	0.083	0.105
PAS and Delivered Meals	0.119	0.004	0.111	0.126
PAS, Adult Day Care, and Delivered Meals	0.127	0.019	0.091	0.164
Constellations with High PAS				
Only PAS	0.100	0.003	0.093	0.106
PAS and Adult Day Care	0.102	0.019	0.066	0.138
PAS and Delivered Meals	0.110	0.007	0.097	0.123
PAS, Adult Day Care, and Delivered Meals	0.132	0.038	0.058	0.207

Table 11: Generalized Estimating Equation Examining Association between HCBS Constellation and Hospitalization

	Coef.	P>z	95% Confidence Interval	
Gender (Male)				
Female	-0.146	>0.001	-0.19	-0.10
Race (White)				
Black, Non-Hispanic	0.232	>0.001	0.17	0.29
Hispanic, White	-0.037	0.68	-0.21	0.14
Asian American	-0.451	>0.001	-0.55	-0.35
Other Race	-0.160	>0.001	-0.25	-0.07
Geographic (Urban)				
Rural	-0.042	0.213	-0.11	0.02
Age Category (65-70)				
70<-75	-0.027	0.413	-0.09	0.04
75<-80	-0.064	0.066	-0.13	0.00
80<-85	-0.054	0.129	-0.12	0.02
85+	0.012	0.717	-0.05	0.08
CHC Phase (Southwestern PAS)				
South Eastern PA	-0.347	>0.001	-0.42	-0.27
Northern and Central PA	-0.019	0.587	-0.09	0.05
Level of Disability				
Continence	0.016	>0.001	0.01	0.02
ADL	0.043	>0.001	0.03	0.05

Table 11 Continued

IADL	0.060	>0.001	0.05	0.07
Alzheimer's or Related Dementia	-0.108	>0.001	-0.16	-0.05
Living Situation (Lives Alone)				
Lives with Child	-0.021	0.502	-0.08	0.04
Lives Other Person	0.031	0.369	-0.04	0.10
Lives with Spouse	-0.184	>0.001	-0.26	-0.11
Lives with Other Family	-0.013	0.732	-0.08	0.06
Time Observed in the Data	0.015	>0.001	0.01	0.02
Constellations of Care (NFI)				
Low PAS				
Only PAS	0.210	>0.001	0.15	0.27
PAS and Adult Day Care	-0.484	>0.001	-0.60	-0.36
PAS and Delivered Meals	0.304	>0.001	0.23	0.38
PAS, Adult Day Care, and Delivered Meals	-0.153	0.343	-0.47	0.16
Medium PAS				
Only PAS	-0.140	>0.001	-0.21	-0.07
PAS and Adult Day Care	-0.366	>0.001	-0.54	-0.19
PAS and Delivered Meals	-0.093	0.065	-0.19	0.01
PAS, Adult Day Care, and Delivered Meals	-0.037	0.871	-0.48	0.40
High PAS				
Only PAS	-0.235	>0.001	-0.34	-0.13
PAS and Adult Day Care	-0.207	0.341	-0.63	0.22
PAS and Delivered Meals	-0.138	0.108	-0.31	0.03
PAS, Adult Day Care, and Delivered Meals	0.169	0.627	-0.51	0.85

Table 11 Continued

Count of Chronic Conditions (0-1 diseases)				
2-3	0.127	>0.001	0.06	0.20
4-5	0.493	>0.001	0.43	0.56
6+	1.218	>0.001	1.15	1.28
Constant	-2.841	>0.001	-2.96	-2.72

Appendix B Chapter 4

Below are two additional tables to that further explain the results of this study. The table in Appendix A (Table 12) is the first stage regression analysis producing the instrumental variable. The table in Appendix B (Table 13) is the second stage of a two stage least square model that, using the same IV model, examines the relationship between the risk of mortality and use of consumer directed care.

Table 12: First Stage of the Two Stage Least Squares Regression

Variable	Coefficient	Std. Err.	P>t	95% Confidence Interval	
Gender (Male)					
Female	-0.005	0.003	0.051	-0.011	0.000
Race (White)					
African American	0.121	0.003	<0.001	0.115	0.127
Hispanic	-0.006	0.010	0.588	-0.026	0.015
Asian American	-0.009	0.004	0.044	-0.017	0.000
Other Race	0.041	0.005	<0.001	0.032	0.051
Geography (Urban)					
Rural	0.034	0.004	<0.001	0.026	0.042
Age (65-70)					
70-75	-0.041	0.004	<0.001	-0.048	-0.033
75-80	-0.062	0.004	<0.001	-0.069	-0.054
80-85	-0.052	0.004	<0.001	-0.060	-0.045
85+	-0.076	0.004	<0.001	-0.083	-0.069
Location in Pennsylvania (Southwestern PA)					
Northern and Central PA	-0.007	0.004	0.108	-0.015	0.002
Eastern PA	0.023	0.005	<0.001	0.014	0.033
Disability Level					
Alzheimer's or Related Dementia Diagnosis	-0.003	0.003	0.311	-0.009	0.003

Table 12 Continued

Continence (0-10)	-0.002	0.000	<0.001	-0.002	-0.001
ADL (0-10)	0.002	0.001	0.007	0.000	0.003
IADL (0-10)	0.006	0.001	<0.001	0.005	0.008
Living Situation (Lives Alone)					
Lives with an Adult Child	0.158	0.003	<0.001	0.151	0.164
Lives with Another Person	0.067	0.005	<0.001	0.058	0.076
Lives with Spouse	-0.003	0.004	0.379	-0.011	0.004
Lives with other Family	0.154	0.004	<0.001	0.147	0.162
Time Observed in our Data	0.002	0.000	<0.001	0.001	0.003
Number of Chronic Conditions (0-1)					
(2-3)	0.088	0.003	<0.001	0.081	0.095
(4-5)	0.112	0.004	<0.001	0.105	0.120
(6+)	0.096	0.004	<0.001	0.089	0.103
Percent of People in using Consumer Directed PAS	0.916	0.014	<0.001	0.888	0.944
Constant	-0.169	0.008	<0.001	-0.184	-0.154

Table 13: Second Stage of Two Stage Least Square Instrumental Variable Model Examining Relationship Between Risk for Mortality and Use of Consumer Directed PAS

Variable	Coefficient	Std. Err.	P>z	95% Confidence Interval	
Gender (Male)					
Female	-0.0027	0.0007	<0.001	-0.0041	-0.0013
Race (White)					
African American	0.0003	0.0010	0.755	-0.0017	0.0023
Hispanic	-0.0041	0.0028	0.143	-0.0095	0.0014
Asian American	-0.0035	0.0012	0.002	-0.0058	-0.0013
Other Race	-0.0030	0.0013	0.025	-0.0055	-0.0004
Geography (Urban)					
Rural	0.0007	0.0011	0.553	-0.0015	0.0029
Age (65-70)					
70-75	0.0016	0.0011	0.133	-0.0005	0.0037
75-80	0.0028	0.0011	0.01	0.0007	0.0049
80-85	0.0020	0.0011	0.064	-0.0001	0.0042
85+	0.0079	0.0011	<0.001	0.0058	0.0099
Location in Pennsylvania (Southwestern PA)					
Southeastern PA	-0.0051	0.0012	<0.001	-0.0073	-0.0028
Northern and Central PA	-0.0021	0.0013	0.107	-0.0047	0.0005
Disability Level					

Table 13 Continued

Alzheimer's or Related Dementia Diagnosis	-0.0023	0.0008	0.003	-0.0039	-0.0008
Continence (0-10)	0.0004	0.0001	0.001	0.0002	0.0006
ADL (0-10)	0.0001	0.0002	0.521	-0.0002	0.0005
IADL (0-10)	0.0013	0.0002	<0.001	0.0008	0.0017
Living Situation (Lives Alone)					
Lives with an Adult Child	0.0008	0.0011	0.474	-0.0014	0.0030
Lives with Another Person	0.0012	0.0013	0.359	-0.0013	0.0037
Lives with Spouse	-0.0010	0.0010	0.34	-0.0029	0.0010
Lives with other Family	-0.0015	0.0012	0.233	-0.0039	0.0009
Time Observed in our Data	-0.0013	0.0001	<0.001	-0.0015	-0.0011
Number of Chronic Conditions (0-1)					
(2-3)	-0.0028	0.0010	0.005	-0.0048	-0.0008
(4-5)	-0.0036	0.0011	0.001	-0.0057	-0.0014
(6+)	-0.0021	0.0010	0.043	-0.0041	-0.0001
Use of Consumer Directed PAS	0.0036	0.0042	0.393	-0.0047	0.0119
Constant	0.0130	0.0020	<0.001	0.0091	0.0169

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