COMMUNITY VERSUS FACILITY LONG-TERM CARE: IMPACTS ON MEDICARE SPENDING AND SERVICE USE

Ila Hughes Broyles

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Approved by:

Morris Weinberger

G. Mark Holmes

Courtney Van Houtven

Philip Sloane

Kristin Reiter

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ABSTRACT

ILA HUGHES BROYLES: Community versus Facility Long-Term Care: Impacts on Medicare Spending and Service Use
(Under the direction of Morris Weinberger)

Older Medicare beneficiaries with disabilities are a high-cost Medicare population and use substantial amounts of health care. A distinctive feature of this population is their use of long-term care (LTC), which can be provided in a facility (e.g., nursing facility, assisted living facility) or the community. This dissertation examined the effect of facility LTC versus community LTC on Medicare expenditures and service use among fee-for-service Medicare beneficiaries from 2000-2009.

I examined facility LTC's effect on: Medicare expenditures for inpatient and physician services (Aim 1); Medicare expenditures for sub-acute services (skilled nursing facility, home health, and hospice) (Aim 2); and emergency department (ED) visits, observation days, and likelihood of 30-day or 60-day hospital readmission (Aim 3). To illuminate the role of competing mortality, I implemented most models as survival-adjusted models. To account for potential unobservable differences among those who used community versus facility LTC, I used an instrumental variables approach in all models. The primary dataset for the dissertation was the Medicare Current Beneficiary Survey, supplemented with public data on LTC supply.

Incident facility LTC users had substantially lower adjusted cumulative survival. In Aim 1, this higher mortality for facility LTC users decreased cumulative Medicare expenditures on both inpatient and physician services, because individuals were progressively less likely to survive and use services. However, non-significant effects on intensity of service when individuals were alive yielded a non-significant total effect on each expenditure type. In Aim 2, higher mortality again decreased expenditures. However, facility LTC increased intensity of sub-acute service use when alive. The combined effects translated to significantly higher sub-acute expenditures for facility LTC users in early months, though the countervailing effects resulted in a non-significant total effect in later months. In Aim 3, facility LTC increased counts of ED visits, largely due to differences in service

intensity when alive. Facility LTC had a non-significant effect on likelihood of 30-day or 60-day readmission. Together, this dissertation suggests LTC facilities affect residents' healthcare use. Payment and benefit design should seek to reward the integration of LTC and healthcare delivery into more appropriate and efficient use of Medicare-covered services for vulnerable older adults.

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PREFACE

This dissertation is organized in a non-traditional format. The first chapter provides a brief introduction to the topic and the specific aims of the dissertation. Chapter 2 provides a literature review and a conceptual model for the study. Chapter 3 includes an overview of the approach taken in each study aim. Chapters 4, 5, and 6 are manuscripts for the three study aims, intended to stand alone as publishable manuscripts and thus have redundancies with other chapters. Chapter 7 provides a summary of findings and policy implications and suggestions for future research.

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LIST OF ABBREVIATIONS

ACO—Accountable Care Organization

ADL—activities of daily living

ALF—assisted living facility

CCRC—continuing care retirement community

COPD—chronic obstructive pulmonary disease

IADL—instrumental activities of daily living

IV—instrumental variable

ED—emergency department

LTC—long-term care

MCBS—Medicare Current Beneficiary Survey

NF—nursing facility

OAA—Older Americans Act

PPS—prospective payment system

RUCA—Rural Urban Commuting Area

SNF—skilled nursing facility

CHAPTER 1. INTRODUCTION

1.1. Background

Increasing healthcare expenditures are threatening Medicare solvency and driving the U.S. healthcare crisis. Disabled older adults are among those Medicare beneficiaries with the highest healthcare costs.[1,2] In addition to substantial healthcare needs, disabled older adults often require long-term care (LTC). LTC provides help with daily activities (e.g., bathing, eating) and can be delivered in a facility such as nursing facilities (NF) and assisted living facilities (ALFs) ("facility LTC") or in community settings like one's own home ("community LTC").

Though Medicare does not pay for LTC, facility LTC providers have large influence on residents' healthcare use and face financial incentives to increase residents' Medicare-covered healthcare use. Prior research suggested that facility LTC did not increase healthcare service use,[3] however the financial environment for LTC facilities has shifted dramatically since this research was conducted. Changes over the past twenty years (1990 and after) developed or amplified incentives for LTC facilities to increase healthcare use. Incentives include diminished liability (if they recommend the most aggressive treatment), decreased costs of providing care (if residents are in the hospital), and the prospect of higher margins (if patients receive Medicare-covered rehabilitation services provided by the facility).

1.2. Study Purpose and Specific Aims

The overall objective of this research was to identify whether facility LTC affects Medicare expenditures and healthcare outcomes. My central hypothesis was that facility LTC increased use of Medicare-covered service, relative to community LTC, due to financial incentives and increased access to providers. I tested my central hypothesis by pursuing the following three specific aims:

Aim 1 To identify whether facility LTC affects Medicare expenditures for acute care and physician/practitioner services (e.g., nurse practitioner, etc.) among disabled older adults.

Hypothesis 1	*Facility LTC will result in higher Medicare expenditures for acute care but not of physician/practitioner services relative to community LTC.*
Aim 2	To identify whether facility LTC affects Medicare expenditures for sub-acute care (skilled nursing facility, home health, and hospice) among disabled older adults.
Hypothesis 2	*Facility LTC will result in higher Medicare expenditures for sub-acute care relative to community LTC.*
Aim 3	To determine whether facility LTC and its associated healthcare use result in potentially avoidable health services utilization, specifically emergency department (ED) visits, hospital observation days, and re-hospitalizations.
Hypothesis 3	*Facility LTC will result in more potentially avoidable healthcare use relative to community LTC.*

1.3. Study Significance

This study was significant because it sought to determine the effect of a policy-modifiable factor, LTC setting, on healthcare expenditures for high-cost Medicare beneficiaries. The identification of modifiable factors that can reduce Medicare expenditures and improve program efficiency is immediately relevant to policymakers and providers. Currently, policymakers are experimenting with new payment mechanisms in Medicare. This research could illuminate how and whether LTC settings may be affecting healthcare costs. This understanding could be incorporated into current and future payment mechanisms that incentivize LTC providers to help bend the Medicare cost-curve. Additionally, ongoing work to “re-balance” Medicaid spending on LTC toward more community LTC could receive more attention if policymakers see potential savings to Medicare as a by-product of such efforts.

CHAPTER 2. LITERATURE REVIEW AND CONCEPTUAL MODEL

2.1. Disability, LTC, and Medicare Costs among the Elderly

Identifying the causes of high healthcare costs has become a major research priority as concerns about U.S. healthcare spending, particularly in Medicare, continue to grow.[4,5] Cost-containment interventions that focus on the highest cost beneficiaries have the potential to achieve the greatest savings.[6] This has led to investment of researcher time and focus, as well as federal research funding, on patients with multi-morbidity and/or transitional care between settings.[7] Unfortunately, though they may improve care delivery or patient experience, neither care management for patients with multi-morbidity nor efforts to improve transitional care have consistently achieved Medicare cost savings among high-cost beneficiaries.[8,9,10] Thus, clear solutions for stemming cost growth among high-cost populations remains a stubborn problem.

Medicare beneficiaries with disabilities are among the highest cost beneficiaries, even after adjusting for comorbidity.[11,12,13,14] Medicare beneficiaries with chronic conditions *and* disabilities have higher spending than individuals with chronic conditions only, regardless of the number of multi-morbidities.[15] A distinctive feature of this population, as compared to other high-cost healthcare users, is their use of long-term care (LTC). Disabled beneficiaries often need LTC, which can be provided in a facility such as a nursing facility (NF) or assisted living facility (ALF) or in the community, from paid or unpaid caregivers. In addition to having disabilities that require LTC, the costliest Medicare beneficiaries are disproportionately likely to receive facility LTC.[16] However, Medicare does not cover LTC that provides ongoing help with disabilities, regardless of the setting. As a result, once multi-morbidity is controlled, there is no clear *medical* reason that disabilities and associated use of LTC should increase Medicare expenditures.

2.2. Previous Research on LTC and Medicare Costs

Much previous research on the role of LTC in Medicare costs has been hindered by methodological challenges. Facility LTC users likely have higher rates of chronic disease and medical complexity compared to other disabled individuals.[17] Without considering selection effects, researchers may have trouble distinguishing the effects of facility LTC from multi-morbidity, for example, and inadvertently attribute the costs due to chronic disease to the receipt of facility LTC. No recent studies have identified how LTC setting (facility versus community) affects Medicare expenditures while adequately considering the selection effects involved in LTC setting. Some investigators used LTC setting as a proxy for disability level without adjusting for the unobserved characteristics that may influence LTC setting. A previous study on the effects of disability on 1993 Medicare expenditures used facility LTC residence as a proxy for high level of disability,[18] however this work did not explicitly consider selection effects and used Medicare expenditures prior to the imposition of the skilled nursing facility prospective payment system. Guralnik and colleagues examined transitions to higher levels of disability and found that high healthcare costs were associated with transitions to facility-based LTC without considering selection effects.[19]

Previous studies that sought to address selection effects involved in LTC setting are either dated, struggled to find adequate control groups, or limited the type of LTC services they examined. The many experimental demonstrations that examined the cost-effectiveness of community LTC occurred in the late 1970s and early 1980s and found that community-based LTC did not reduce healthcare costs.[20] However, these occurred when Medicare payment dynamics, particularly for nursing facilities, were very different. The most notable of these, the Channeling Demonstration—a national demonstration to delay nursing home admission that finished in 1985—found that delaying nursing home admission did not reduce healthcare expenditures, possibly because researchers could not identify and enroll patients at risk for nursing home admission as a control group.[21] Other work that explicitly sought to control for selection effects examined only one type of community LTC. Van Houtven and Edwards found that receipt of informal care, a type of LTC typically provided in the community, reduced acute and sub-acute Medicare expenditures for beneficiaries in 1993 and 1995.[22]

2.3. Changing Financial Environment for Facility LTC Providers

In the past two decades (the time elapsed since the last major experimental research on LTC's effect on Medicare costs) the financial environment for facility LTC providers has changed substantially. First, the payment dynamics for NFs changed. The growth in NF revenues from Medicare rehabilitation care grew dramatically from 1980 to 2000. Most NFs, over 90% in 2012[23], are dually certified and act as both Medicaid LTC facilities and Medicare skilled nursing facilities (SNFs). However, the presence of Medicare rehabilitation services in NF service delivery is a relatively new development. Formerly, NFs almost exclusively focused on traditional custodial LTC for residents, often paid for by Medicaid, as opposed to rehabilitation services following hospitalization ("sub-acute care") paid for by Medicare.[24] Medicare's spending on NF sub-acute care constituted 1.6% of total U.S. spending on nursing homes in 1980.[25] Following the implementation of the inpatient prospective payment system, decreasing hospital length-of-stay created a new reliance on post-hospitalization rehabilitative care and the sub-acute market grew.[26,27] By 2004, Medicare payments for sub-acute care were 13.9% of U.S. payments to nursing homes.[28] This segment of NF business was more profitable to NFs than custodial LTC care, particularly that paid by Medicaid. Within the study period, Medicare margins for SNFs remained high and climbed over the decade, whereas non-Medicare margins remained negative over the decade (see Table 2.1). From 1999 to 2007, while the total number of Medicare beneficiaries receiving sub-acute SNF services grew by 33%, expenditures on these services increased by 88%.[29] Due to the higher margins, the incentive to increase use of this new, more profitable Medicare SNF benefit, which requires a three-day hospitalization, likely changed NF behavior. Specifically, it may have altered the healthcare delivery to NFs' custodial LTC patients, particularly inpatient and SNF services.

In addition to major growth in the sub-acute portion of NF revenues, Medicaid payments to NFs also changed during the study period. Many states implemented Medicaid bed-hold policies, where they paid NFs to "hold" beds for residents receiving Medicaid-paid LTC who were admitted to hospitals—this allowed the NF to receive payment and provide no services while residents were hospitalized. Evidence suggests that this incentive increased hospitalizations in dually certified NFs. Intrator and colleagues found that hospitalization odds were higher by 36% in states with bed-hold

policies.[30] In a similar study, Grabowski and colleagues found that state introduction of a Medicaid bed-hold policy increased 30-day rehospitalizations for Medicare patients by 1.8%.[31] Because this change would constitute only a spillover effect from changing payments for hospitalization of Medicaid LTC patients, it is possible that hospitalization for long-stay Medicaid patients went up even higher. Implementation of these bed-hold policies evidently changed hospitalization practices for NF residents.

Second, the ALF market grew dramatically, with large growth in for-profit entities offering assisted living services. These facilities provided custodial care to a disabled population. There is evidence that ALFs served a similar group of patients as NFs. In addition to providing help with ADLs and IADLs, ALFs can offer physical therapy, occupational therapy, and some skilled nursing services. Residents of ALFs also have a high degree of disability and very high levels of chronic conditions.[32] This descriptive information about resident similarity is validated by recent research, which suggests that ALFs may substitute for NF. One study found that a 10% increase in ALF capacity led to a 1.4% decline in NF private-pay occupancy and a 0.2–0.6% decline in overall NF patient acuity.[33] In combination, it seems that ALFs offer an alternative to NF care for some clinically similar individuals.

Though they are not providers of sub-acute SNF care, ALFs also faced incentives to increase medical care. One financial incentive is the existence of a de facto bed-hold policy. ALFs, which are mostly paid privately, often require continued payment if residents are hospitalized or are admitted to SNFs for rehabilitation. Thus, if a resident is hospitalized or admitted to an SNF, the facility receives "rent" but does not have to pay for labor to provide LTC. These bed/room-hold rates are often negotiated during admission to the ALFs and patients and their families can instead opt to be discharged and lose their bed or room. Most patients in ALFs are private pay, but some are paid for by Medicaid. Currently, only a handful of states have an ALF Medicaid "bed-hold" payment policy in such cases (similar to a NF Medicaid bed-hold payment), but such policies do exist.[34] These bed hold policies may serve as an incentive to increase inpatient and SNF care for ALF residents.

In addition to the payment incentives affecting hospitalization and SNF care, ALFs and NFs both faced liability concerns that may have encouraged them to increase medical care. Kaiser Family Foundation recently conducted a survey of LTC facilities, including a range of ALFs and NFs, to

understand why residents were hospitalized.[35] Concerns about liability were a common financial concern that drove hospitalizations for both types of facilities. Additionally, the survey reported that physicians believe they receive higher compensation for visits when they see patients in the hospital versus the LTC facility.

In addition to the changes to hospitalization and SNF incentives, policy and payment changes that impact physician and similar provider service use among facility LTC residents also occurred. Legislation in the late 1980s required NFs to provide regular physician (or substituting professional) assessments of residents at 30- or 60-day intervals.[36] This legislation also strengthened the requirements for medical directors in LTC facilities (particularly NFs), which could lower barriers to physician care for those in LTC facilities. However, qualitative evidence after this legislation suggests that LTC facility residents experienced minimal access to physicians, with monitoring by nursing staff substituting for physician care.[37] Lower reimbursement for and logistical difficulty in delivering care in LTC facilities[38] and the national decrease in the number of geriatricians being trained[39] could have affected the availability of physician services in LTC facilities. On balance, these factors may have canceled one another out and led to no effect of facility LTC use on Medicare expenditures on physician services.

These changes, including the change in the NF financial environment and growth of ALFs, may have shaped or changed facility LTC providers' effect on residents' healthcare use. NFs and ALFs faced incentives to increase Medicare-reimbursed acute care because, if residents were hospitalized, facilities bore no costs of care while still receiving payments to hold the bed. ALFs had similar incentives when beneficiaries were admitted to SNFs following hospitalizations. NFs also had incentives to increase SNF sub-acute care, and encourage the required hospitalization, because they could then receive higher Medicare SNF payments, especially compared to Medicaid-paid LTC. These incentives drove my hypothesis that changing payment dynamics altered delivery of medical care to facility LTC users, particularly acute and SNF care.

2.4. Research Question and Hypotheses

Given the changes in the financial environment for LTC facilities, the overall objective of this research was to identify whether facility LTC use affects Medicare expenditures and healthcare

outcomes. My central hypothesis was that facility LTC use increased use of Medicare-covered service, relative to community LTC, due to financial incentives and increased access to providers. I tested my central hypothesis by pursuing the following three specific aims:

Aim 1: To identify whether facility LTC affects Medicare expenditures for acute care and physician/practitioner services (e.g., nurse practitioner, etc.) among disabled older adults.

Aim 2: To identify whether facility LTC affects Medicare expenditures for sub-acute care among disabled older adults.

Aim 3: To determine whether facility LTC and its associated healthcare use result in potentially avoidable health services use, specifically emergency department (ED) visits, hospital observation days, and re-hospitalizations.

I hypothesized that facility LTC use would increase expenditures on hospitalizations and sub-acute care as well as counts of potentially avoidable health services use but would not affect expenditures on physician services, relative to community LTC.

2.5. Conceptual Model

To examine the research question and drive the hypotheses, this research relied on a conceptual model informed by both the Andersen Behavioral Model and an understanding of the financial environment for LTC providers. Andersen's model identified three categories that explain healthcare service use, breaking characteristics into (1) predisposing characteristics (demographic descriptors such as age or race), (2) enabling factors (which allow healthcare service use to take place, such as proximity to providers, transportation, and insurance status), and (3) need for services (both perceived and real).

My conceptual model borrows from the Andersen model to explain how healthcare needs and LTC needs can interact (Figure 2.1). This model makes a clear distinction between healthcare and LTC: healthcare needs are needs met by skilled services or technologies provided in the medical system (nursing, drugs, etc.) whereas LTC needs are disabilities that require help with activities of daily living (bathing, dressing, etc.) or instrumental activities of daily living (paying bills, etc.). These two needs, as well as the services that meet them, are separate but can interact. Most important, LTC

service use can result in changes to the enabling factors for healthcare service use (see highlighted pathway in Figure 2.1).

Specifically, my conceptual model suggests that where LTC is delivered ("setting of LTC") acts as an enabling characteristic for healthcare use. In particular, facilities that deliver LTC have increased access to healthcare services through relationships with hospitals or other providers. They may also have financial incentives to increase service use for some services, particularly acute and sub-acute care. These financial incentives take several forms and are described in detail in Section 2.3. Due to the financial incentives for facilities, I hypothesized that individuals who receive facility LTC will have higher healthcare services use, particularly acute (Aim 1) and sub-acute care (Aim 2) and potentially avoidable healthcare use such as ED visits and readmissions (Aim 3), as a result of this enabling characteristic. In my model, facility LTC acts as a more potent enabling characteristic for healthcare use compared to community LTC.

2.6. Instruments

The conceptual model also supports the use of the proposed instruments to predict LTC setting within the study population (disabled older adults receiving LTC). Instrumental variables require you to identify exogenous variables ("instruments") that will predict treatment. However, these variables must *only* affect your outcome through your treatment, once other covariates are controlled for ("the exclusion restriction"). I sought to identify instruments that would predict LTC setting (facility versus community LTC) but not healthcare use, outside of pathways for which I can explicitly control (income, education, race, etc.).

Number of Adult Children

Among disabled beneficiaries receiving LTC, a higher number of adult children should be correlated with a lower likelihood of receiving facility LTC. Number of adult children should act as an enabling characteristic for community LTC, because they provide informal caregiving that can entirely or partially meet an individuals' LTC needs. However, number of adult children should predict neither co-morbidities nor acuity of disease that leads to healthcare use.

Previous researchers have used number of adult children as an instrument to predict informal caregiving.[40] The central theory is that the number of adult children is a supply factor for informal

caregiving (and thus increases the use of informal caregiving). Informal caregiving then acts as a substitute for facility LTC use. Thus, an increasing number of adult children should decrease facility LTC use.

Currently, informal caregiving represents the bulk of long-term care in the United States. In addition to spouses, adult children are a major source of informal caregiving.[41] For individuals ages 60 to 75 living the community with 2+ ADLs, spouses act as primary caregivers for about 50% of adults and children act as primary caregivers for about 35% of adults. However, for those over age 75, children provide the majority of caregiving.[42]

The number of children can affect the availability of informal caregiving in multiple ways. Caregiving responsibilities may be shared across more siblings as family sizes grow.[43] This can directly increase the availability of caregivers and the duration of informal caregiving, because sharing the workload could help prevent caregiver burnout. Both of these increase the supply of informal caregiving. Importantly, the protective effect against burnout, although enhanced by geographic proximity, is not entirely limited by geography. Adult children located at a distance can provide emotional support to a sibling providing primary caregiving support.[44] This may bolster the quality (and duration) of informal caregiving available and thus the supply.

Threats to the Exclusion Restriction

First, although fertility and health status may be simultaneous for the childbearing population, there should be no direct causal relationship between previous fertility and current health needs for older adults. Fertility, with rare exceptions, ends well before the age of the study population (ages 50 and older).

There are several indirect effects that are possible. It is possible that previous fertility affects income among older adults and thus health status (e.g., a woman who quit working due to childbearing and childrearing may have saved less and, as a result, have less income as an older adult). However, income can be controlled for, using reported entry income and education levels (as a proxy).

Second, there is a possibility that previous fertility was affected by previous mental health status or previous health status, both of which could also affect an older adult's current health status. However, current health status can be controlled for as well.

Finally, there is the threat of unobservable characteristics that affect both previous fertility and current health status. Although this is always a risk for instruments, the time gap between previous fertility and current health status should allay some of these concerns.

Supply of Assisted Living and CCRCs

Among disabled beneficiaries receiving LTC, the supply of LTC facilities in a beneficiaries' geographic area should not be correlated with healthcare service use once local healthcare facility supply is controlled for (e.g., hospitals, etc.). The local supply of ALFs and continuing care retirement communities (CCRCs) in particular should act as an enabling characteristic for facility LTC service use but not of healthcare use.

Changes in the geographic supply of LTC facilities over the study period could predict LTC facility residence. As the U.S. population ages, the supply of ALFs and CCRCs has increased rapidly, especially in the early part of the study period (2000–2006) but varied substantially by geography, so there was expected to be substantial variation in these items over the study period.[45]

There are multiple pathways through which supply of ALFs and CCRCs could affect LTC facility use. First, the availability of these facilities may act as a substitute for nursing home care. Recent research suggests that the availability of ALFs decreases low-care nursing home residents marginally.[46] There are other pathways in which assisted living facilities do not act as substitutes but as complements. These pathways assume that, on average, these types of facilities may be a more palatable setting than a traditional NFs for older adults who consider themselves only minorly disabled (but are unable to live independently). The availability of an ALF or CCRC in one's area may offer a "facility entry point" for someone who would otherwise enter a NF but perhaps cannot find one with beds available or suitable to their preferences or for someone who had disabilities but did not feel disabled enough to enter one. Both types of individuals may enter a NF at a later point. A third minor pathway is that increased availability of these facilities may make residence in any kind of LTC facility more palatable and encourage individuals to move into some other kind of LTC facility.

Notably, individuals most likely to be influenced by these supply factors are individuals who are able to afford to pay for ALFs and CCRCs. Although new surveys reflect that ALFs are more varied in price and luxury than was formerly understood, residential care facilities still serve a primarily private-pay population.[47] Thus, the treatment effect of this instrument will be concentrated among individuals able to afford private-pay LTC. However, because approximately 40% of residential care facilities had at least one resident for whom LTC was paid, in some part, by Medicaid,[48] the effect should not *only* be to upper-income populations.

Threats to the Exclusion Restriction

Because Medicare does not directly pay for LTC and these facilities (CCRCs and ALFs) do not also supply healthcare, the availability of ALFs and CCRCs should not affect individuals' healthcare use unless they are living in the facility. Thus, there should be no direct effects that violate the exclusion restriction.

There is one primary indirect effect that supply of these facilities could have on healthcare use. Economic prosperity could have increased the supply of both these facilities and other healthcare facilities simultaneously. As a result, economic prosperity (which increases the availability of these facilities) could also increase healthcare spending for individuals. However, we can control for geographic characteristics, time trends, and other healthcare provider supply characteristics (e.g.,skilled nursing facilities) that would act as the pathway for the effect of economic prosperity.

Supply of Home-Delivered Meals

The availability of publicly funded community LTC support such as Meals on Wheels could act as a supply factor that increases community LTC use. Home-delivered meals likely act as a complement to other informal and formal caregiving in the community. However, because it is determined at an area level, it does not co-vary with individual-level LTC need characteristics that could also affect healthcare access (such as dementia, etc.). Emerging research validates this hypothesis. State spending on OAA-funded Meals on Wheels decreased the prevalence of nursing facility residents that were classified as low-care.[49] The study was at the state level, included community-level fixed effects, and suggested that increased access to these programs may decrease likelihood of nursing facility admission among individuals able to live in the community.

Threats to the Exclusion Restriction

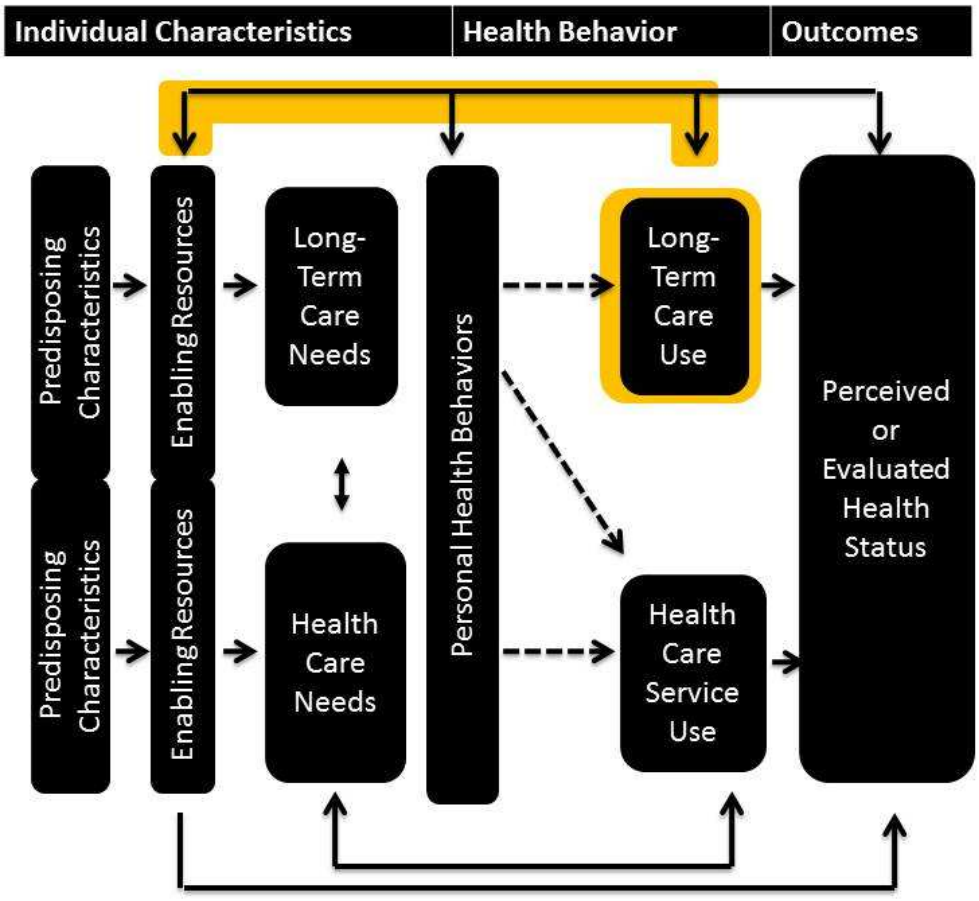
Funding for Meals on Wheels may be predicted by other community-level factors that also affect healthcare availability and delivery. State-wide commitment to community LTC as well as other factors that may also affect healthcare use, such as Medicaid funding, could affect Meals on Wheels. Thus, we controlled for average state Medicaid per diem for nursing facilities and the percentage of state Medicaid budgets spent on home-and-community-based services. It is also likely that state funding for Meals on Wheels is also affected by the general community-level supply factors that were previously discussed and were controlled for in the analysis.

Table 2.1.

Nursing Facility Margins

Medicare[50]	17%[51]	9.4%[52]	13.7%	13.3%	16.6%	18.5%
For-profit[53]			16.1%	15.7%	19.1%	20.7%
Non-profit[54]			3.5%	3.5%	6.9%	9.5%
Non-Medicare[55]	-.7%	-2.8%	-1.3%	-.9%	-2.6%	-1.2%
Overall[56]	.9%	1.1%	1.7%	2.2%	2.1%	3.6

Figure 2.1. Conceptual model.



CHAPTER 3. APPROACH

3.1. Overview and Rationale

This study sought to identify the comparative effect of incident facility LTC versus community LTC on Medicare expenditures and potentially avoidable healthcare use. To achieve this objective, the study used nationally collected survey and claims data in an observational design. A major challenge to achieving the study purpose was methodological. Both multi-morbidity and mortality directly increase healthcare use and are highly prevalent among disabled older adults. Because of this high prevalence, it is difficult to identify adequate control groups for individuals who receive facility LTC. However, by using advanced econometric techniques, including instrumental variables (IVs), this research sought to address selection effects and determine the independent effect of facility LTC use on Medicare expenditures. Additionally, given the higher risk of mortality in our older, disabled population of interest, the approach sought to account for competing risk from mortality by using survival-adjusted models, which explicitly model mortality, where it was feasible.

The Medicare Current Beneficiary Survey (MCBS), a nationally representative survey matched with claims data, served as the primary data source. Each of the study aims used an IV approach to compensate for possible selection effects when comparing beneficiaries receiving facility LTC versus community LTC. The potential instruments predicting likelihood of facility LTC versus community LTC were the same for all aims and included (1) number of adult children, (2) supply of LTC facilities in their geographic area (e.g., assisted living facilities (ALF) and continuing care retirement communities (CCRC), etc.), and (3) state-level funding for home-delivered meals for homebound individuals (Meals on Wheels). Each aim also incorporated survival-adjusted methodologies,[57] because this is the best measure of cost in a population with higher likelihood of death. To determine the effect of LTC setting on service-specific Medicare expenditures, Aim 1 used generalized linear models with dependent variables of Medicare expenditures on acute and physician/practitioner services. Aim 2 also used generalized linear model with a dependent variable of

Medicare expenditures on sub-acute services, including skilled nursing facility (SNF), home health, and hospice care. To determine the effect on avoidable health services use, Aim 3 used generalized linear models estimating counts (ED visits and number of hospital observation days) and maximum likelihood models estimating likelihood of any services (30- and 60-day hospital readmission).

3.2. Data Sources

The Medicare Current Beneficiary Survey (MCBS) comprised the bulk of the data used in all Aims. The MCBS is a nationally representative panel survey of Medicare beneficiaries. Panels are introduced annually and followed for four years (see Figure 3.1). Survey information is available *only for the fall of each year* (Figure 3.1). In addition to collecting demographic information, the MCBS survey asks participants questions about disability, LTC services, and health status. The survey data is matched to other information that is *gathered continuously*, including Medicare claims containing the healthcare service use and expenditures of participants and residence tracking (such as between the community and a facility). The file includes information about geographic location of participants (to the zip code level). I combined information from the Access to Care file and the Cost & Use file to obtain survey information for four consecutive calendar years and used claims information from the Cost & Use file to provide Medicare service use for the later three years.

The U.S. Census ZIP Code Business Patterns provided additional data on the local supply of LTC providers in the study participants' geographic area. The Zip Code Business Patterns are intended to provide information on employers in geographic areas.[58] I used them to identify the number of assisted living facilities (ALFs) and continuing retirement communities (CCRCs) in each zip code in each year (proposed instruments) as well as the number of SNFs (controls). I matched these supply characteristics to MCBS participants using the zip code. Additionally, I used 2000–2009 spending data from the State Program Reports, which are publicly available from the Administration on Aging.[59] These provided data on state spending on home-delivered meals (proposed instrument) funded through Title III-C2 of the Older Americans Act of 1965, which I translated into per capita amounts for the over 65 population. Medicaid payment rates for NFs and percent of Medicaid spending on home and community-based services (HCBS) came from the Brown University LTCFocus Web site. I combined these sources to create an analytical file that followed MCBS

participants in the survey for years 2000–2009 and included their survey responses and LTC supply over time.

3.3. Sample

I sought to identify a sample of individuals who are *at risk for* facility LTC use or at equipoise between facility and community LTC. To identify this group, I needed to identify individuals who could feasibly receive community LTC and do not *have to* receive facility LTC. Thus, the sampling frame included individuals who enter the MCBS living in the community and did not use facility LTC for the first three months in the survey (see Figure 3.2). Medicare-paid skilled nursing facility (SNF) stays alone did not qualify as facility LTC use (and thus an exclusion from the sampling frame), because these are healthcare services, as defined in the conceptual model, and an outcome of Aim 2 of this dissertation. However, if the three-month look-back period *only* included a Medicare-paid SNF stay, the individual was excluded, because prior use of facility LTC before the SNF stay was unknown.

To delineate the time period in which someone was eligible for treatment versus the outcome period, I defined 3 time categories: a wash-out period for their first three months in the survey (January–March), a treatment period of from April 1 to March 31, and an outcome period from April 1 until the end of their participation in the MCBS (see Figure 3.3). To ensure there were enough treated individuals, there were two treatment periods per cohort (see Figure 3.3). We included a second potential treatment window (April 1, Year 2, to March 31, Year 3) for those who were eligible for but did not use facility LTC during the first treatment window. Controls were identified from those who received community-based LTC during the first treatment period for each cohort.

As discussed, the sampling frame included individuals who entered the MCBS living in the community and did not use facility LTC during the wash-out period, with a few additional exclusion criteria. Medicare beneficiaries under the age of fifty were excluded. If individuals entered a mental health or psychiatric center or residence for the care of the mentally retarded/developmentally disabled at any point during the survey, they were not included in the sampling frame. If an individual had missing information on the number of adult children or if they lived in Puerto Rico, they were also excluded.

Sample Identification

Within the sampling frame specified (those at risk of facility LTC use), I identified two samples:

Sample #1: The first sample was a clinically similar group of patients gathered by matching community LTC users to facility LTC users by age. I separated out individuals in the sampling frame into 3-year age "bins" (i.e. 50–52, 53–55, etc.). For each individual who used facility LTC during the treatment window, I randomly selected three individuals in the same three-year age bin (ages 50+) who received community-based LTC. I used a "greedy" matching process in which community LTC users (controls) could be sampled multiple times. This allowed me to homogenize the sample and ensured I was using the instrument to predict facility LTC use in a similar group of individuals. This group of facility LTC and community LTC users comprised Sample 1.

Sample #2: The second sample was comprised from all discharges that occurred during the outcome period for all facility LTC users (treated) and community LTC users (controls) individuals outlined in the sampling frame.

3.4. Key Variables and Measures

Exposures

The most critical measure was treatment, or receipt of LTC. Incident facility LTC (treatment initiation) occurred when someone moved to a LTC facility during the treatment period (after they began the survey in the community and used no facility LTC during the wash-out period). For this analysis, LTC facilities included NFs, ALFs (which includes board & care home, domiciliary care facilities, personal care facilities, rest home/retirement homes), and CCRCs.

The decision to include ALF residents with NF residents among the treated was threefold. ALFs (1) act as financial entities with responsibilities for financial stewardship and, in many cases, profitability; (2) face financial incentives to increase medical care (similar to NFs); and (3) house clinically similar patients, some of whom go on to receive nursing facility care. First, ALFs act as independent financial entities that house residents, have at least some say in their medical treatment, and yet must prioritize financial concerns to remain open. Although there is heterogeneity in ALFs from small private homes to corporately owned, large facilities, over 80% of facilities were for-profit by

2010.[60] These facilities must balance patient care concerns with their own financial well-being. Second, although ALFs do not offer SNF care, they still face incentives to increase medical care. One financial incentive is the existence of a de facto bed-hold policy for private-pay residents, detailed in the conceptual model (Section 2.3). Liability is likely another major incentive to increase medical care, especially because ALFs may have less medical staff than NFs. Third, there is not a definitive clinical distinction between residents of NFs and ALFs. In addition to providing help with functional limitations, ALFs can offer physical therapy, occupational therapy, and some skilled nursing services. Residents of ALFs have a high degree of disability and very high levels of chronic conditions.[61] This descriptive information is validated by recent research, which suggests that ALFs may substitute for NF care. One study found that a 10% increase in ALF capacity led to a 1.4% decline in NF private-pay occupancy and a 0.2–0.6% decline in overall NF patient acuity.[62] In combination, it seems that ALFs offer an alternative to NF care for some clinically similar individuals. Finally, many ALF users in our sample go on to use NF care (only 19% of sample 1 used exclusively ALFs). In summary, because ALFs face financial incentives to increase healthcare, the care they deliver is similar to care delivered in a NF, and residents often go on to receive NF care, residents who entered an ALF for the first time were grouped among the treated for this analysis.

Individuals received "community LTC" if they reported receiving help with any ADL in their survey responses during the treatment period and lived in the community for the entirety of the survey. If they received Medicare-covered SNF care with no accompanying Medicaid or private pay-covered LTC facility stay, they were still considered to have lived in the community.

Outcomes

The outcomes data, including all Medicare expenditures and service use, was gathered from Medicare fee-for-service claims. The MCBS provides extensive claims information, which undergoes a rigorous reconciliation process. Monthly expenditures outcomes were generated from claims and allocated to calendar months. If a claim covered more than one month, the claim was split by the proportion of days of the claim within that calendar month. Claims were converted to 2004 real dollars using the medical consumer price index, because much LTCFocus data used 2004 dollars. Inpatient claims were used for the inpatient outcome; physician claims were used for the physician and

provider outcome; SNF, home health, and hospice claims were used for the sub-acute expenditure outcome; outpatient claims were used for ED visits (identified using revenue center codes 450–459 or 981); and observation days were identified using the outpatient and inpatient claims. Readmissions were identified using the Yale All-Cause Readmission Definition[63] and generated from the inpatient claims file. See Table 3.1 for a summary of dependent variables by aim and source claims files.

Covariates

I sought to identify and operationalize the key pre-disposing, enabling, and need factors for healthcare use among disabled older adults (listed in Table 3.2) as covariates. All variables listed came from the MCBS from the fall prior to the treatment window, with the exception of local-level healthcare supply and LTC funding, which came from the year the treatment window started.

I included predisposing characteristics including age, gender, level of education (high school, some college, and college graduate), and race (African American), all of which were gathered via self-report. The lack of inclusion of more granular race and ethnicity categories was due to very low numbers in the treated sample. I included enabling characteristics such as Medicaid eligibility at any point in the year preceding the treatment window, rural residence (three categories defined by RUCA codes by zip code), Census region geographic area, and elements predicting LTC service use (state Medicaid % spending on HCBS, state NF per diem rates). Local healthcare supply was intended to be hospital and SNF counts in the beneficiary's zip code but low variation in hospital counts led to collinearity and thus only SNF counts were used.

Functional status was the primary identification of disability and LTC need. Functional status was generally measured by a person's level of dependence in ADLs (bathing, dressing, eating, getting out of chair, walking, and toileting) or IADLs (using the telephone, doing light housework, doing heavy housework, preparing meals, shopping, and paying bills). In the community, the variable asks whether the individual usually has any difficulty with an ADL and the potential responses are yes, no, or does not do (in which case there is a follow-up question of whether the individual does not do them due to health problems). Thus, for ADL variables, I combined responses to create six binary variables indicating any difficulty in the corresponding six ADLs. From this, I created a continuous

measure for ADL disability to account for the gradation of ADL disabilities by taking the sum of all six of the binary ADL variables.

To capture if a person considered him or herself semi-independent physically while still exhibiting some functional dependence, I created another variable that indicates that the person exhibits any IADL needs. Similar to ADLs, the MCBS asks whether the individual usually has any difficulty with using the telephone, and the potential responses are yes, no, or does not do (in which case there is a follow-up question of whether the individual does not do them due to health problems). For IADLs, I created a single binary variable indicating difficulty in any IADL and counted any indication of difficulty with any of these activities. However, almost the entire sample had IADL disability, thus we were not able to include it in the final model. Finally, I used survey responses on a variety of cognitive functional measures to assess presence of any cognitive limitation.

The most important healthcare need factors were diagnoses. To identify co-morbidities, I used survey responses of whether someone had ever received a variety of diagnoses including hip fracture, breathing problems (including asthma, emphysema, or COPD), Alzheimer's, diabetes, non-skin cancer, stroke, congestive heart failure, hypertension, angina, arteriosclerotic heart disease, myocardial infarction, and heart arrhythmias.

Instruments

Number of adult children was taken from survey responses and run as a continuous variable. Zip-code level counts of ALFs and CCRCs were represented as counts and were also continuous. State spending on Meals on Wheels was translated to state per capita spending for the over-65 population and translated to 2004 dollars, to be consistent with all dollar measures in the analysis.

3.5. Analytic Files

I constructed two analytic files. The first file (Analytic File #1) contained observations as a person-period record. Periods were calendar months. All participants had a record for all periods, even after death or censoring. In addition to all covariates and dependent variables, each observation included an indicator of whether the beneficiary died within the period (D) and an indicator of whether the beneficiary was censored at any point before the end of the period or died in a previous period (C). Individuals were censored at any point if they enrolled in a Medicare HMO (including the first

period), because the outcome of Medicare costs was no longer observable. The second file (Analytic File #2) was limited to individuals with hospital discharges and had observations as person–hospital discharge combinations. It included indicators for 30- and 60-day readmission in each file, death within 30 or 60 days, or censoring within 30 or 60 days due to HMO enrollment or survey roll-off.

3.6. General Analytic Approach

I implemented an IV approach for all outcomes, using survival-adjusted methods[64] for all outcomes except 30- and 60-day readmissions. IVs accounted for unobservable differences between facility and community LTC users. The survival-adjusted model allowed me to decompose the total effect of facility LTC on healthcare service use to a portion due to service intensity versus a portion due to survival differences.

Main treatment was use of facility LTC (T). The first stage (eq1) predicted facility LTC based on included covariates and instrumental variables, as discussed in the conceptual model. X was a vector of the pre-disposing, enabling, and need characteristics listed in Table 3.2.

$$\widehat{FLTC_j} = \beta_0 + \beta_1 * Instruments_j + \beta_2 * X_j + \varepsilon_{1j} \quad \text{(eq1)}$$

The second stage models estimated survival and healthcare use ($\hat{\mu}_j$). They included the residuals from eq1 (because all second stages incorporated non-linear estimation techniques)[65] as well as the treatment of facility LTC ($FLTC$) and other pre-disposing, enabling, and need characteristics (X) listed in Table 3.2 but excluded the instruments.

The specification of the second-stage models for each Aim is listed in Table 3.3. For models 6 and 7 (Table 3.3), I constructed a logistic model estimating likelihood of hospital readmission as the second stage. For models 1–5 (Table 3.3), I estimated the survival-adjusted healthcare use in the following steps: (1) for all person-periods in which the beneficiary survived and was not censored, I estimated a survival model using discrete-time methods and logistic regression, which allowed me to calculate the hazard function for death $\hat{h}_j(t,x)$ and the predicted probability of survival $\hat{S}_j(t,x)$, as well as the marginal effect of facility LTC on each of these; (2) for all person-periods when the beneficiary died, I estimated the period's predicted healthcare service $\hat{\mu}_{1j}(t,x)$ and the marginal effect of facility LTC on healthcare service $\partial\hat{\mu}_{1j}(t,x)/\partial T$; (3) for all person-periods when the beneficiary survived and

was uncensored, I estimated the period's predicted healthcare service $\hat{\mu}_{2j}(t,x)$ and the marginal effect of treatment on healthcare service $\partial\hat{\mu}_{2j}(t,x)/\partial T$.[66]

In a survival model, the estimated healthcare service use in a given period for any individual is $\hat{\mu}_j = \hat{S}_j(X) * \left[\hat{h}_j(X) * \hat{\mu}_{1j}(X) + (1 - \hat{h}_j(X) * \hat{\mu}_{2j}(X)\right]$, or the weighted sum of the utilization conditional on survival to that period and death in that period. The total estimated utilization over the period $\hat{\mu}(X)$ is the sum of the period-specific estimates $\hat{\mu}(X) = \sum_{j=1}^{K} \hat{\mu}_j(X)$. The marginal effect of a covariate in X—for example, receiving LTC in a facility—on $\hat{\mu}_j$ can be broken down into individual effects on utilization due to survival differences (first curly bracket in eq 2) and service intensity (second curly bracket).[67]

$$\partial\hat{\mu}/\partial T = \sum_{j=1}^{K}\left[\begin{array}{c}\left\{\begin{array}{c}\frac{\partial\hat{S}_j(X)}{\partial X}\left[\hat{h}_j(X) * \hat{\mu}_{1j}(X) + (1 - \hat{h}_j(X) * (\hat{\mu}_{2j}(X))\right] \\ +\hat{S}_j(X) * \left[\frac{\partial\hat{h}_j(X)}{\partial X}\left(\hat{\mu}_{1j}(X) - \hat{\mu}_{2j}(X)\right)\right]\end{array}\right\} + \\ \left\{\hat{S}_j(X)\left[\hat{h}_j(X) * \frac{\partial\hat{\mu}_{1j}(X)}{\partial X} + \left(1 - \hat{h}_j(X)\right) * \frac{\partial\hat{\mu}_{2j}(X)}{\partial T}\right]\right\}\end{array}\right] \qquad \text{(eq2)}$$

Each element of the marginal effect was calculated through the steps listed previously. The final step involved combining these estimates to calculate the total marginal effects (eq2), which was also presented as the two partial effects due to service intensity versus survival differences.

In all models, we used a two-staged residual inclusion technique, as mentioned previously.[68] However, for the survival-adjusted models (all models except for readmission), we implemented a 2SRI-based strategy with two deviations from the typical approach. First, we used the residual in the *probit* space rather than the more common *probability* space, analogous to the inverse Mills ratio in a classic Heckman model.[69] Second, due to collinearity between the residual and the covariates (mean variance inflation factor >10), we had poorly behaved estimation algorithms. Thus, we simulated the residual by conducting multiple replications with a random draw from the standard normal distribution consistent with the parameter estimates. We simulated a value of $\hat{\varepsilon}_1$ given the true value of treatment (similar to but not the same as the Inverse Mills Ratio). The major advantage of this approach is that it allowed us to include a residual term but eliminated problems with collinearity. The major disadvantage of this approach is that it is really $\hat{\varepsilon}_1 + \omega$ (the simulated piece) and thus is a noisy estimate of $\hat{\varepsilon}_1$. Measurement error tends to bias coefficients on the residual toward zero and creates risk of finding no effect or a smaller effect when there is an effect or larger effect. This could

cause tests of endogeneity (such as the test of the significance of the residual term in the second stage) to fail to reject exogeneity when, in fact, endogeneity is present. Thus, we conducted a range of endogeneity tests and implemented models as IVs, to be conservative.

Aim 1: Analyses

I constructed two different second-stage models with similar structure and analysis for each but with different dependent variables (see Table 3.3). I constructed both models using Analytic File #1. The survival-adjusted approach described in the General Analytic Strategy was the same across both models. As mentioned in the general analytic approach, the instrumented variable was facility LTC. I applied a generalized linear model for both second-stage models. The dependent variable was expenditures on inpatient care in Model 1 and, for Model 2, expenditures on physician and practitioner services (e.g., nurse practitioner, physical therapy, etc.), including outpatient labs. I bootstrapped 5,000 replications to obtain standard errors for both predicted services use and marginal effects of facility LTC.

Aim 2: Analysis

The approach, including the model specification, was the same as Aim 1 (see Table 3.3). For this Aim, I used Analytic File #1. Again, the instrumented variable was use of facility LTC. I applied a generalized linear model in the second stage. The dependent variable was Medicare expenditures on SNF, home health, and hospice care. I bootstrapped to obtain standard errors for both predicted service use and marginal effects of facility LTC.

Aim 3: Analyses

The third aim used instrumental variables to estimate the effect of facility LTC on potentially avoidable services use over time. I planned to estimate five different models with different dependent variables (see Table 3.3). In this aim, all dependent variables for ED visits, hospital observation days, and re-admissions were binary or count measures.

For models 4 and 5, I planned to use a survival-adjusted generalized linear model using a Poisson link to estimate counts of ED visits within the time period and counts of hospital observation days. I conducted models 4 and 5 using Analytic File #1. However, due to an insufficient number of

observation days in the sample, I was not able to implement the model for the observation days (model 4) and only modeled ED visits (model 5).

For models 6 and 7, I planned to use logistic regression to estimate the treatment's effect on likelihood of 30-day and 60-day hospital readmission. Models 6 and 7 used Sample #2, which includes only those with a hospital admission. The logistic model specifies the likelihood of readmission as

$\text{Prob}(\text{Readmit}|\text{X}_{ij}) = e^{XB}/(1+e^{XB})$, where $X_i\beta_j = \beta_0 + \beta_1 F - LTC + \beta_4 * X_{ij} + \varepsilon_{2ij} + \varepsilon_{1jt}$ (eq6)

Again, X is a vector of pre-disposing, enabling, and need characteristics listed in Table 3.2. I bootstrapped to obtain standard errors for both predicted services use and marginal effects of facility LTC.

3.7. Sample Size and Statistical Power

For all aims, incident facility LTC users comprised the treatment group. Using the sampling frame explained earlier, I initially estimated that I would have roughly 1000 incident facility LTC person-year combinations. Although these numbers were roughly met (n=985), censoring due to HMO enrollment and admission to a psychiatric hospital reduced the treated group to n=864. Initial power calculations were made using the programs powerreg and powerlog for Stata 11.0. These analyses allow me to detect the required sample size to detect a minimum effect size—α=0.05 with power ≥ 80%. To change predictive accuracy of the R^2=.01 from the addition of my key variable (facility LTC) with 30 control variables, I would need a sample size of 780 for continuous outcomes (spending). To detect a change in .05 predicted probability of a dichotomous outcome, I would need a sample size of 630. In both instances the estimated N of incident facility LTC person-year combinations gives a sufficient sample size for Sample 1. For the dependent variable of readmissions, due to the high healthcare use of this population, I expected this to be a majority of incident facility LTC users. To detect a change in α=.05 predicted probability of a dichotomous outcome, I needed a sample size of cases of 480 with power ≥ 75%. However, because I had approximately 430 readmissions within 30 days and 550 readmissions within 60 days, I may have insufficient power to test the effect on readmissions within 30 days and 60 days. To address the

sufficiency of power, I included a composite outcome of death or readmission, which increased cases for 30 day readmission up to 840 and for 60 day readmission up to 1,068.

Figure 3.1. Structure of Medicare Current Beneficiary Survey.

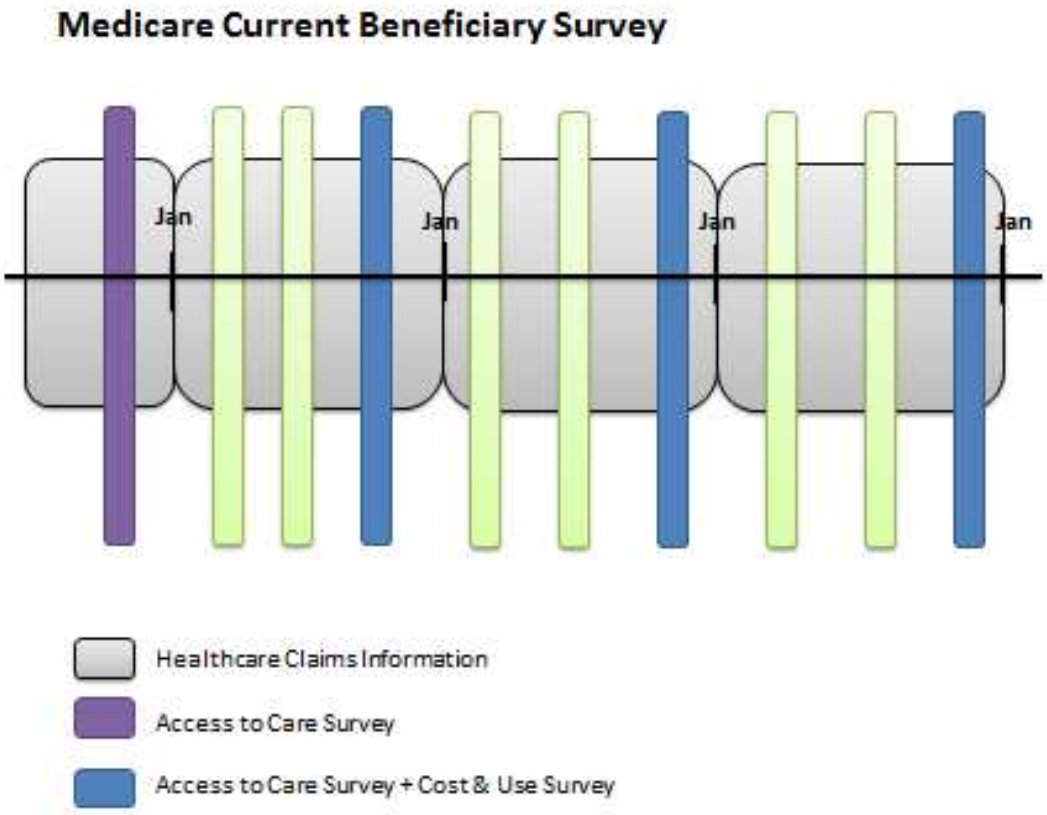


Figure 3.2. Sampling frame and exclusion criteria.

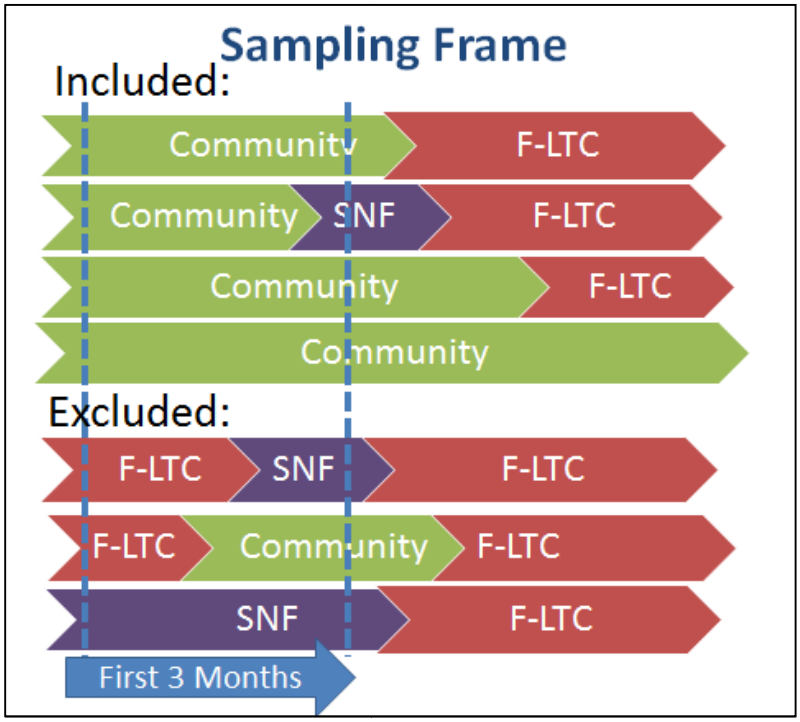


Figure 3.3. Study period segmentation.

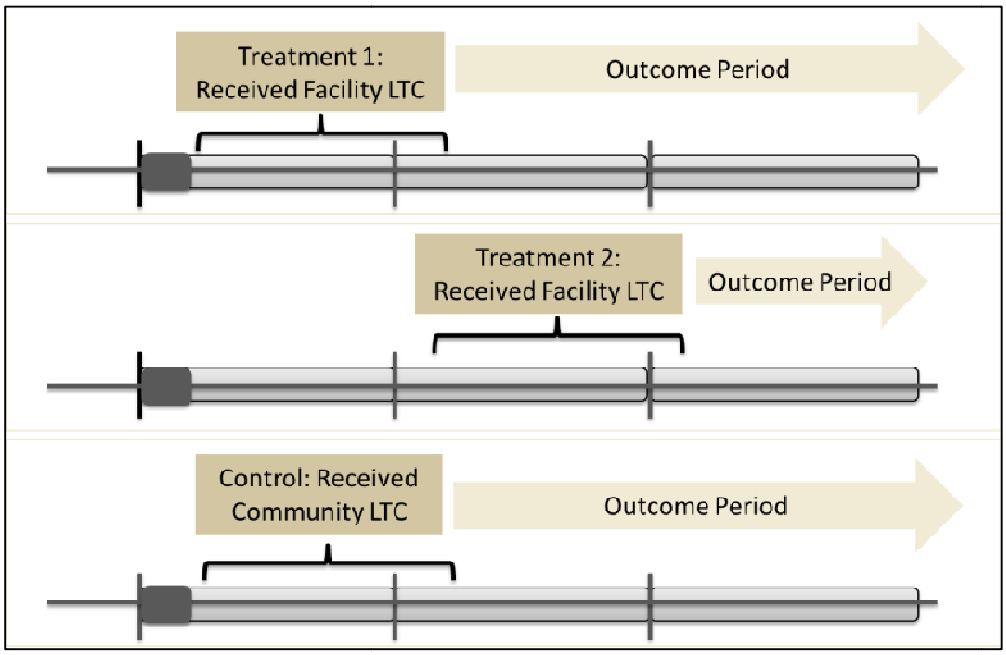


Table 3.1.

Dependent Variables and Source Files

Aim	Dependent Variable	Source Claims File	Additional Notes
1	Medicare Acute Care Expenditures	Inpatient	
	Medicare Physician/Practitioner Expenditures	Physician	
2	Medicare Sub-Acute Care Expenditures	SNF, Home Health, and Hospice	
3	Number of ED Visits	Outpatient	Revenue center codes 450-459 or 981
	Number of Hospital Observation Days	Outpatient and Inpatient	Revenue Center codes and HCPCS codes
	Likelihood of 30-day hospital readmissions	Inpatient	Yale All-Cause Unplanned Hospital Readmission
	Likelihood of 60-day hospital readmissions	Inpatient	Yale All-Cause Hospital Readmission

Table 3.2.

Covariates

	Factors Affecting Health Care Use	Variable Type
Predisposing	Age	Continuous
	Gender	Categorical
	Marital Status	Categorical
	Education (Highest)	Categorical
	Race/Ethnicity	Categorical
Enabling	Medicaid Eligibility	Categorical
	Geographic Location (RUCA Codes)	Categorical
	State LTC Spending (% Medicaid on HCBS, Medicaid NF per diem)	Continuous
	Local LTC Supply (Hospital SNF counts by Zip Code)	Continuous
Need	Diagnoses	Categorical
	Cognitive Limitations	Categorical
	Charlson Comorbidity Index	Continuous
	ADLs	Continuous
	Any IADL	Categorical

Table 3.3.

Second Stage Models

Model Specification				
Aim	**Model**	**Dependent Variable**	**Second Stage Model**	**Sample Restrictions**
1	1	Medicare Acute Care Expenditures	Survival-adjusted Generalized Linear Model	None (Analytic File 1)
	2	Medicare Physician/Practitioner Expenditures	Survival-adjusted Generalized Linear Model	None (Analytic File 1)
2	3	Medicare Sub-Acute Care Expenditures	Survival-adjusted Generalized Linear Model	None (Analytic File 1)
3	4	Number of ED Visits	Survival-adjusted Generalized Linear Model	None (Analytic File 1)
	5	Number of Hospital Observation Days	Survival-adjusted Generalized Linear Model	None (Analytic File 1)
	6	Likelihood of 30-day hospital readmissions	Logit Model	Individuals with ≥1 hospital stay (Analytic File 2)
	7	Likelihood of 60-day hospital readmissions	Logit Model	Individuals with ≥1 hospital stay (Analytic File 2)

CHAPTER 4. AIM 1

4.1. Introduction

Identifying strategies to bend the Medicare cost-curve is a significant and ongoing policy concern.[70,71] Medicare beneficiaries with disabilities are among the highest cost beneficiaries to Medicare, even after adjusting for comorbidity.[72,73,74,75,76] Medicare beneficiaries with chronic conditions and disabilities have higher spending than individuals with chronic conditions only, regardless of the number of comorbidities.[77] Due to the disproportionate healthcare spending on this population, new policies and programs introduced under the Affordable Care Act (e.g., ACOs, the Community-based Care Transitions Program, etc.) will need to target older, disabled Medicare beneficiaries to achieve Medicare savings. However, to successfully reduce only excess healthcare use, policymakers must first understand what drives the outsized healthcare spending on this vulnerable population.

One important driver of healthcare costs among older Medicare beneficiaries with disabilities is long-term care (LTC) that helps with activities of daily activities (e.g., bathing, eating). LTC may be delivered in community settings (e.g., patients' homes) by paid or unpaid caregivers or in facilities such as nursing facilities (NF) and assisted living facilities (ALF). Although Medicare does not cover custodial facility-based LTC, LTC facilities have consistent, ongoing interactions with residents and likely influence their Medicare-covered healthcare use. Experimental demonstrations in the 1970s and 1980s found no difference in healthcare costs between those receiving community-based LTC versus NF care.[78] However, since these demonstrations, changes in the financial environment for LTC facilities created new incentives for facility LTC providers to increase healthcare use by their residents. Given the new environment, the purpose of this study was to explore whether LTC setting (community versus facility) affects Medicare expenditures for inpatient or physician services among older beneficiaries with disabilities.

Changing Environment for LTC Facilities since the 1980s

Since the Medicare experimental demonstrations that showed no difference in healthcare costs by LTC setting, several changes in the payment dynamics for LTC facilities may have increased hospitalizations for facility LTC residents. First, prospective payment systems decreased hospital length of stays and increased reliance on sub-acute skilled nursing facility (SNF) care following hospitalization.[79] Medicare paid well for these sub-acute services, particularly in the 1990s, and NFs began to focus on the relative profitability of Medicare reimbursement for sub-acute SNF care compared to Medicaid reimbursement for traditional custodial NF care. As a result, from the late 1980s to the early 2000s, NFs increasingly focused on sub-acute care and revenue from SNF patients, despite Medicare policy changes that attempted to stem cost growth in this area.[80] Receiving Medicare-covered SNF rehabilitation benefits required a qualifying 3-day hospitalization. Therefore, an incentive to shift patients from Medicaid-reimbursed NF care to Medicare-reimbursed SNF care could have increased hospitalization rates among NF residents.

Second, many states implemented Medicaid bed-hold policies for custodial LTC, where Medicaid paid NFs to hold beds for enrollees admitted to the hospital. These bed-hold policies allowed NFs to receive payment from Medicaid without providing services. Although the payment protected residents from losing their spots, these bed-hold payments increased hospitalizations for NF residents.[81,82]

Third, the ALF market grew dramatically[83] and Medicaid began paying ALFs for LTC services. ALFs substituted for NF services in certain patient populations.[84] Additionally, ALFs faced incentives to increase hospitalizations of their residents, because ALFs often required continued private-pay payment when residents were hospitalized.[85] Similar to the Medicaid bed-hold policy in NFs, continued payments without the costs of providing LTC created an incentive to hospitalize ALF residents. Finally, concerns about liability and physician accessibility and reimbursement may have created incentives for both NFs and ALFs to hospitalize patients.[86]

Although most policy changes favored increased hospitalizations of facility LTC residents, it is unclear how policy and payment changes from the 1990s to the 2000s affected physician service use among facility LTC residents. Two factors may have increased facility LTC residents' use of physician services. First, OBRA legislation of the late 1980s required NFs to provide regular physician (or

substituting professional) assessments of residents at 30- or 60-day intervals.[87] Second, OBRA strengthened requirements for medical directors in LTC facilities (particularly NFs), which could lower barriers to physician care for those in LTC facilities relative to disabled individuals in the community. However, qualitative evidence suggests that LTC facility residents experienced minimal access to physicians,[88] with monitoring by nursing staff substituting for physician care. Lower reimbursement, logistical difficulty in delivering care in LTC facilities,[89] and the national decrease in the number of geriatricians being trained[90] could have reduced the supply of physician services in LTC facilities. On balance, these factors may have canceled one another out and led to no effect of facility LTC use on Medicare expenditures on physician services.

Research on LTC Setting in the New Financial and Policy Environment

Since these changes, there has been limited research revisiting the effect of LTC setting on Medicare expenditures. The receipt of informal care decreased Medicare expenditures on acute services in the early 1990s.[91,92] Other studies found that bed-hold policies were associated with higher hospitalization rates among NF residents[93],[94] and, among dual eligibles, residence in NFs relative to the community increased their risk of hospitalization.[95] However, researchers have not revisited the effect of facility LTC in the general LTC population, and none of these studies explicitly modeled the effects of mortality and its potential role in healthcare service use.

Given the urgency of scrutinizing Medicare costs and the changes in the LTC facility landscape, we examined whether and to what extent incident facility LTC affects Medicare expenditures for inpatient care and physician expenses. We hypothesized that, among older Medicare beneficiaries with disabilities, those receiving facility LTC would have higher Medicare expenditures for inpatient care but not for physician care compared to those receiving community LTC.

4.2. Methods

We tested our hypothesis using an instrumental variables (IV) approach within a survival-adjusted model to account for (1) the likelihood of unobservable differences between facility LTC versus community LTC users and (2) the prevalence of mortality among older and disabled adults.

Survival-Adjusted Model Construction

Because the population of interest had a non-trivial risk of death, end-of-life associated costs were an important component of their healthcare expenditures. Traditional modeling that predicts resource use when death is a competing risk, such as multinomial models, often treat death and healthcare service use as mutually exclusive outcomes, which they are not. Alternatively, researchers might exclude those who die, yet death may be on the pathway through which treatment affects costs. Healthcare costs around the time of death tend to increase, yet death also acts as a competing risk for healthcare use and can decrease healthcare costs because there is no opportunity to use services (and incur costs) after death.

Thus, we modeled Medicare expenditures using survival-adjusted methods that explicitly model the role of survival trajectories in healthcare service use. They also allow decomposition of a treatment effect on expenditures into two parts: (1) changes in patient survival and (2) intensity of service use.[96,97] In brief, we estimated three different models: (1) a survival model for all person-periods in which the beneficiary survived and was not censored using discrete-time survival methods and a probit model; this allowed us to calculate the hazard function for death $\hat{h}_j(t,x)$ and the predicted probability of survival $\hat{S}_j(t,x)$, as well as the marginal effect of facility LTC on each of these; (2) a generalized linear model predicting expenditures conditional on death in that period, from which we generated the period's predicted expenditures $\hat{\mu}_{1j}\ (t,x)$ and the marginal effect of facility LTC on expenditures $\partial\hat{\mu}_{1j}(t,x)/\partial T$; and (3) a generalized linear model estimating expenditures conditional on survival in the period, from which we estimated the period's predicted expenditures $\hat{\mu}_{2j}(t,x)$ and the marginal effect of facility LTC on expenditures $\partial\hat{\mu}_{2j}(t,x)/\partial T$. A modified Park Test was used to identify the correct family in the generalized linear models.

In a survival model, the estimated healthcare service expenditure in a given period for any individual is $\hat{\mu}_j = \hat{S}_j(X) * \left[\hat{h}_j(X) * \hat{\mu}_{1j}(X) + \ (1 - \hat{h}_j(X) * \hat{\mu}_{2j}(X)\right]$, or the weighted sum of the expenditures conditional on survival to that period and death in that period. The total estimated expenditure over the period $\hat{\mu}(X)$ is the sum of the period-specific estimates $\hat{\mu}(X) = \ \sum_{j=1}^{K} \hat{\mu}_j(X)$. The marginal effect of a covariate in X—for example, receiving LTC in a facility—on $\hat{\mu}_j$ can be broken down into individual effects

on expenditures due to survival differences (first curly bracket below) and service intensity (second curly bracket):

$$\partial\hat{\mu}/\partial T = \sum_{j=1}^{K}\left[\begin{Bmatrix}\frac{\partial\hat{S}_j(X)}{\partial X}\left[\hat{h}_j(X) * \hat{\mu}_{1j}(X) + (1-\hat{h}_j(X) * (\hat{\mu}_{2j}(X))\right] \\ +\hat{S}_j(X) * \left[\frac{\partial\hat{h}_j(X)}{\partial X}\left(\hat{\mu}_{1j}(X) - \hat{\mu}_{2j}(X)\right)\right]\end{Bmatrix}\right.$$

$$\left. + \left\{\hat{S}_j(X)\left[\hat{h}_j(X) * \frac{\partial\hat{\mu}_{1j}(X)}{\partial X} + \left(1-\hat{h}_j(X)\right) * \frac{\partial\hat{\mu}_{2j}(X)}{\partial X}\right]\right\}\right]$$

Greater detail on the survival-model construction can be found at Basu & Manning (2010) and Federspiel et al. (2013). Marginal effects were bootstrapped using 5,000 replications to generate confidence intervals.

Implementing IV

Another key challenge to this research was possible selection bias due to unobservable differences between incident users of facility LTC and those who received community LTC. To address these concerns, we used IVs to account for potential bias due to unobservable differences in the two groups. Valid IVs should be associated with the "treatment" (here, use of LTC facility) but not otherwise associated with the outcome (Medicare expenditures). We proposed three IVs. First, number of children has been used as an instrument to predict the effect of informal caregiving (a type of community LTC) on healthcare use.[98,99,100] Second, we considered local supply of LTC facilities, including ALFs and continuing care retirement communities (CCRC), and third, state-level spending on home-delivered meals (Meals on Wheels). These instruments should affect facility LTC service use but not healthcare use directly when controlling for local healthcare facility supply and state spending on home and community-based services (HCBS).[101]

Within the general framework of a survival-adjusted model, each model used IVs to adjust for unobserved confounding factors when comparing facility and community LTC users. The first stage predicted treatment (facility LTC, or FLTC) as a function of the IVs and X, a vector of the pre-disposing, enabling, and need characteristics listed in Table 4.1, using a probit model.

$$\widehat{FLTC}_{jt} = \beta_0 + \beta_1 * Instruments_{jt} + \beta_2 * X_{jt} + \varepsilon_{1jt}$$

The three second-stage models were estimated, predicting survival and Medicare expenditures. Due to non-linear models in the second stage and a discrete endogenous variable, the IV analysis required the use of a two-stage residual inclusion (2SRI) method,[102] in which the residuals from the first stage were included, as well as the treatment of facility LTC ($FLTC_{jt}$), and other pre-disposing, enabling, and need characteristics (X) listed in Table 4.1.

We implemented a 2SRI-based strategy, with two deviations from the typical approach. First, we used the residual in the *probit* space rather than the more common *probability* space, analogous to the inverse Mills ratio in a classic Heckman model[103]. Second, because collinearity between the residual and the covariates (mean variance inflation factor >10) led to poorly behaved estimation algorithms, we simulated the residual by conducting multiple replications with a random draw from the standard normal distribution consistent with the parameter estimates. See Appendix 1 for details.

Data Source and Sample

Information about individuals and their healthcare use came from the nationally representative 2000–2009 Medicare Current Beneficiary Survey (MCBS).[104] Panels of beneficiaries are introduced annually and followed for four years. Information on LTC supply came from: (1) U.S. Census ZIP Code Business Patterns, which provided data on the local supply of LTC providers (CCRCs, ALFs, and NFs) in participants' zip code area;[105] (2) State Program Reports provided 2000–2009 state-level spending on home-delivered meals funded through Title III-C2 of the Older Americans Act of 1965, which we translated into per capita amounts for the over-65 population;[106] and (3) Medicaid payment rates for NFs and percent of Medicaid spending on HCBS came from the Brown University LTCFocus Web site. For the survival-adjusted analytic method, data files were constructed such that observations were person-months. Periods in our analysis were calendar months because the SSA-verified MCBS death date listed the calendar month of death.

The retrospective study period was designed to have three periods (Figure 4.1): (1) a wash-out period that included an individual's first three months in the survey, or January 1 to March 31 of Year 1; (2) the treatment window (April 1, Year 1, to March 31, Year 2); we included a second potential treatment window (April 1, Year 2, to March 31, Year 3) for those who were eligible for but did not use facility LTC

during the first treatment window; and (3) the outcome period started at the end of their treatment window and continued for a maximum 21 months—the outcome period was split into calendar months.

The sample was created by matching incident facility LTC users (treatment group) to community LTC users (controls). Beneficiaries were eligible if they were ages 50 and older, entered the MCBS living in the community, did not use facility LTC during the wash-out period, and used community LTC or facility LTC during the treatment window. Other exclusion criteria included residence in Puerto Rico, missing number of adult children, or individuals who had only an SNF stay during the wash-out period (meaning their SNF stay began before the beginning of the wash-out period and ended after it, so we could not see whether they had previously lived in an LTC facility).

Incident facility LTC use during a one-year treatment window constituted treatment (Figure 4.1). Incident facility use included a non-Medicare–paid stay in an NF or any stay in an ALF as indicated in the residence history file. Assisted living, board & care homes, domiciliary care facility, personal care facilities, rest homes, and adult/group homes were all considered ALFs.

We matched each beneficiary receiving facility LTC to several similarly aged beneficiaries who received community LTC in the first treatment window (April 1, Year 1, to March 31, Year 2) and never went on to receive facility LTC. Community controls were age-matched to facility LTC users within three-year age-bins at a ratio of three community LTC controls for each facility LTC recipient. Individuals were censored due to death, HMO enrollment, or end of survey participation.

Measures

Outcomes: Dependent variables were Medicare expenditures on inpatient or physician services in each calendar month, as well as survival. Monthly expenditures were calculated from Medicare claims. If a claim spanned more than one month, it was apportioned by the proportion of days that occurred within each month. Claims were converted to 2004 real dollars using the medical consumer price index,[107] because much LTCFocus data used 2004 dollars. Survival was constructed from the MCBS data, which offered the month in which death occurred. Each observation included an indicator of whether death occurred in the month or censoring (due to an end in their survey participation, previous death, or HMO enrollment).

Independent Variables: We included key pre-disposing, enabling, and need factors in our model (Table 4.1) that were expected to affect healthcare use.[108] All individual-level covariates from the MCBS were measured in the fall before the wash-out and treatment windows that began the following spring. Supply characteristics came from the calendar year in which the treatment window started.

4.3. Results

The 3,330 beneficiaries in the sample were selected by age-matching incident facility LTC users (26%) with those who only used community LTC (74%) (Table 4.1). The average participant was an 82-year-old unmarried white female with a high school education. Despite age-matching, facility LTC users had higher rates of Alzheimer's Disease ($p < .05$) and lower rates of many cardiovascular diseases ($p < .05$) compared to community LTC users. Surprisingly, they also had a lower number of activities of daily living (ADLs) with which they needed assistance ($p < .05$), our primary measure of functional disability.

Tests of Instruments and Endogeneity

We tested the strength of the proposed IVs (F-test>10). Only number of adult children ($F = 14.77$) passed; all other potential IVs failed the individual test of strength, so all further tests and models were implemented using the one valid IV: number of adult children.

Following a Modified Park test to identify the correct family distributions, we ran all second-stage expenditure models as generalized linear models using the log link and Poisson family. A modified Hausman test of the residual failed to reject the null hypothesis of exogeneity in any of the second-stage models ($p > .05$); however, potential measurement error may have biased the coefficient on the residual toward zero (See Appendix 1).

To sensitivity test, we changed the model to run without diagnoses, married status, and ADLs (to simulate the selection effect, assuming those characteristics affect survival and expenditures). The coefficient on the residual remained non-significant in all three second-stage models, although point estimates changed. We further tested selection effects in the survival model using a bivariate probit with a dichotomous dependent variable of ever dying in the outcome period. Again, we failed to reject the null of no correlation of the error term in the survival model.

To further test selection, we implemented the model as a two-stage predictor substitution with a first-stage linear probability model. This enabled us to test endogeneity using variants of the Hausman

run as an F-test on the coefficients on the: residual when it was included with facility LTC in the second stage; the predicted facility LTC use when it was included with true facility LTC use in the second stage; and the IV when it was included with true facility LTC use in the second stage. We failed to reject the null of exogeneity in the survival model. For inpatient expenditures, we failed to reject exogeneity in the expenditures conditional on survival model ($p < .05$) but rejected the null of exogeneity in the expenditures conditional on death model ($p < .05$). For physician expenditures, we failed to reject exogeneity in either expenditure model. Although we found quite limited evidence of endogeneity, to be conservative we implemented the models as IVs using 2SRI, although we present estimates from non-IV models for contrast below.

Impact of Treatment on Survival

Incident LTC facility use had a large and significant effect on cumulative survival in the outcome period (Figure 4.2). By month 20, incident facility LTC users had a cumulative survival rate of 55.2% (95% CI: 47.4%–61.2%) compared to 75.2% (95% CI: 73.0%–77.5%) in community LTC users (Figure 4.2). Estimates varied only slightly in the IV and non-IV models, suggesting that selection effects did not explain the large differences in survival across groups; sensitivity tests listed above confirmed this finding.

Impact of Treatment on Medicare Inpatient Expenditures

Incident facility LTC use had no significant total marginal effect on cumulative Medicare inpatient expenditures in IV models; however, there was a significant effect on spending due to differences in survival in the IV model (Figure 4.3). Higher mortality in the facility LTC group had mixed impacts of higher expenditures in early months, due to higher mortality and accompanying higher healthcare use in the month of death, followed by savings in later months due to those who die using no services after death. In early months (1–8), facility LTC use led to significantly higher cumulative expenditures due to survival differences; this effect disappeared by month 10. In the last 5 months, however, the lower cumulative survival rate among facility LTC users led to a decrease in expenditures among facility users (compared to community LTC users), ending with a significant cumulative decrease of $411 in the last month (Bias-corrected 95% CI: -$737 to -$192). Facility LTC had no significant effect on spending due to intensity of service use in the IV model (Figure 4.3). These results can be compared to the non-IV model, where there was a positive and significant total marginal effect of facility LTC and a positive marginal

effect due to differences in service intensity. These findings suggested that selection effects were responsible for some of the increased service use when alive.

Impact of Treatment on Medicare Physician Expenditures

Incident facility LTC use had a non-significant total marginal effect on cumulative Medicare expenditures for physician care (Figure 4.3). However, there was a significant effect on spending due to differences in survival (Figure 4.3). In early months (1–3), there was a positive significant marginal effect due to survival differences; by month 7, this effect became a negative significant marginal effect, ending with a significant cumulative effect of -$365 in the last month (Bias-corrected 95% CI: -$477 to -$99). There was no significant effect of facility LTC on spending due to intensity of service use (Figure 4.3). As with inpatient expenditures, the non-IV model showed a positive and significant total marginal effect of facility LTC and a positive marginal effect due to differences in service intensity, suggesting again that selection effects were responsible for some of the increased service use when alive

4.4. Discussion

Given the high use of LTC services by older Medicare beneficiaries with disabilities, understanding how facility LTC use affects Medicare expenditures for physician and inpatient services is critical to policymakers. Ours is the first study to examine this question since major policy changes were implemented in the 1980s and 1990s. Our study contributes several key findings. First, our findings did not support our hypothesis that current financial incentives faced by LTC facilities increased Medicare's expenditures for hospitalization of facility LTC users relative to those receiving community LTC. This is consistent with the findings from demonstrations nearly thirty years ago that found no effect of NF admission on inpatient services[109] despite large changes in the financial and policy context for LTC facilities during the intervening period. This study finds that in the general disabled older population, facility LTC did not increase or decrease Medicare expenditures on inpatient services compared to community LTC users.

Second, we found no effect of facility LTC use on physician services expenditures. This is again consistent with prior demonstrations on delaying NF admissions and may, in part, reflect the role physicians play in NFs. Although research on physicians' role and presence in NFs and ALFs offers limited insight into their availability and involvement, some prior evidence suggests that physicians have a

very limited presence in NFs.[110,111] Even among the small proportion of primary care physicians that practice in NFs, little of their time is spent with NF patients.[112,113]

Third, facility LTC's effects on survival, through which facility LTC decreased expenditures on physician and inpatient services, were unexpected. Observational research has noted that facility LTC admission accelerates physical and/or cognitive decline in older adults.[114,115] Descriptive research also suggests that NF residents die more quickly.[116] A recent study that attempted to account for unobserved selection found at least some independent effect of NF use on mortality. Dementia patients admitted to NF in good health experienced higher mortality compared to similar individuals in the community.[117] Evidence presented here suggests some causal relationship between facility admission and increased mortality. Additional research that validates these relationships and investigates possible causal pathways will be important to understand whether this is an artifact of moving in a frail, older population or reflective of modifiable factors specific to the NF setting (e.g., differences in risk or treatment for infections, falls, emotional well-being).

Limitations

There are several limitations of our study, some of which apply to other exactly identified IV analyses. Although we believe our instrument (number of adult children) stands up to the exclusion restriction and has been used repeatedly as an instrument in similar studies, we were unable to test the instrument. Additionally, IV analyses reduce power, a trade-off in accounting for possible selection effects. Second, we conducted the analysis without sampling weights because: (1) survival-adjusted models have not been validated using weights and (2) we could not use the MCBS weights as provided in our sample, so we would have had to construct our own weights. Thus, our findings may not be nationally generalizable.[118] Third, the beneficiaries using facility LTC included both ALF and NF residents. Many ALF residents transfer to NFs.[119] Incident users of only ALFs (who did not go on to use another type of facility) constitute 19% of the facility LTC group. Evidence from admittedly small samples reflects that ALF and NF residents have similar outcomes with regard to mortality and functional decline.[120] We felt that, given the incentives and similarity in the populations, it was appropriate to group ALF and NF users together, although estimates must be interpreted as local average effects for those entering both types of facility.

Implications for Policy and Practice

Identifying opportunities for reducing Medicare expenditures in high-cost populations will be critical to cost-bending measures of the ACA. LTC facilities can influence their residents' non-NF healthcare use and face ongoing incentives to increase some Medicare services. New financial relationships could change these incentives. ACOs and other new payment structures have created financial ties between LTC facilities and hospitals. Although these payments do not directly address LTC provision, they do create new and deeper ties among hospitals, doctors, and NFs (as well as ALFs, though they cannot explicitly join ACOs). Policymakers and providers should create payment mechanisms that reward LTC facilities that demonstrate the value of their services to Medicare.

Equally important but less clear will be the role of community LTC providers in these new payment and delivery systems. It may be that we found no effect of facility LTC on expenditures, despite the incentives they face, because the diverse spectrum of community LTC providers are not integrated into the healthcare system and are not encouraged to avoid unnecessary healthcare use. Community LTC providers include a range of paid and unpaid workers. Though the proportion of individuals receiving paid community LTC increases steadily after age 60, the majority is provided by family members.[121] In some cases, a patchwork of providers may struggle to meet the needs of declining older adults. In those cases, physician care and hospitalizations can become a stopgap for beneficiaries' safety and well-being, leading to high healthcare use. This leaves community LTC recipients as critical targets for new capitated programs to reduce unnecessary healthcare use. Yet because of the decentralized nature of community LTC that can include family, neighbors, agencies, and independent paid caregivers, ACOs and other bundled payment systems may struggle to integrate community LTC providers. Smaller systems that successfully integrate the range of community LTC supports individuals receive, such as the Program of All-Inclusive Care for the Elderly, provide a window into the intensive coordination and close contact that this type of integration requires.[122]

Our results illuminate the need for continued, rigorous research to inform health policy and cost-reduction efforts. Specifically, our unexpected finding about higher mortality among facility LTC residents highlights the critical role that mortality plays in healthcare costs. Both policymakers and researchers must be aware of this competing risk when examining use and cost in medically vulnerable populations.

Additional research in this and other high-cost populations that incorporates the impacts of end-of-life and examines specific types of healthcare spending could help policymakers and providers understand where to target efforts.

In conclusion, we found that incident facility LTC use did not alter Medicare expenditures on physician services or inpatient services relative to community LTC, despite some savings that accrued due to higher mortality among facility LTC users. Given our results, healthcare systems that seek to reduce hospitalization and other expenditures among disabled older adults must integrate the range of LTC providers, with no one type of LTC provider as “low hanging fruit,” to successfully reduce costs and improve quality in this vulnerable population. This is no easy task for busy healthcare providers. New capitated payment mechanisms that incentivize care coordination efforts may provide reasons and room for this type of LTC integration into healthcare delivery, long overdue in American health care.

Table 4.1.

Descriptive Statistics of Sample Medicare Beneficiaries Receiving LTC

	Community (N=2,466)	Facility (N=864)		Community (N=2,466)	Facility (N=864)
LTC Supply Interest	**Mean (SD) or Percentage**		**Pre-disposing Characteristics**	**Mean (SD) or Percentage**	
Number Children***	3.0 (2.3)	2.5 (2.1)	Age	82.3 (8.4)	82.3 (8.5)
Assisted Living Facilities	1.2 (1.9)	1.2 (1.8)	Married***	43.1%	28.9%
CCRCs	0.4 (0.7)	0.4 (0.8)			
State Spending Delivered Meals	5.2 (2.0)	5.2 (2.1)	Female	67.9%	67.1%
State Medicaid NF Per Diem	149.3 (34.8)	150.5 (34.0)	African American***	13.6%	9%
% Medicaid Spending on HCBS	25.3 (13.4)	24.3 (13.2)			
Enabling Characteristics	**Mean (SD) or Percentage**		**Need Characteristics**	**Mean (SD) or Percentage**	
Education*			Functional Limitation		
Less than High School	48.8%	44.3%	Number of ADLs ***	2.4 (1.8)	1.7 (1.8)
Some College	42.6%	45.1%	Cognitive Limitation	34.1%	34.4%
College Graduate	8.6%	10.5%	Health Conditions		
Census Regions[1] ***			Alzheimers**	11.1%	14.9%
Mountain	6.5%	4.9%	Hip Fracture**	11.6%	8.2%
Pacific	10.6%	8.9%	Diabetes*	26.0%	22.5%
South Atlantic	22.4%	19.3%	Cancer	18.0%	17.2%
Mountain Pacific	6.5%	4.9%	COPD/Emphysema**	17.6%	13.0%
West South Central	10.9%	11.3%	Stroke*	26.5%	22.3%
East South Central	9.3%	7.3%	MI	17.8%	17.5%
West North Central	7.2%	10.3%	CHF	8.8%	7.9%
East North Central	15.0%	20.1%	Arteriosclerosis*	13.8%	10.6%
MidAtlantic	15.7%	15.0%	Arhythmia	13.7%	13.1%
New England	2.3%	2.8%	Angina***	14.4%	9.5%
Rural			Hypertension**	64.3%	58.6%
Urban	70.9%	68.6%			
Large Town	16.4%	16.7%			
Rural	12.7%	14.7%			
Any Medicaid Eligibility***	25.6%	19.3%			

Notes: * indicated p<.05 , ** indicates p<.01, ***p<.001, [1]West includes Alaska, California, Hawaii, Oregon, Washington; Mountain includes Arizona, Colorado, Idaho, Montana, Nevada, New Mexico, Utah, Wyoming; West South Central includes Arkansas, Louisiana, Oklahoma, Texas; East South Central includes Alabama, Kentucky, Mississippi, Tennessee; West North Central includes Iowa, Kansas, Minnesota, Missouri, Nebraska, North Dakota, South Dakota; East North Central includes Illinois, Indiana, Michigan, Ohio, Wisconsin; South Atlantic includes Delaware, District of Columbia, Florida, Georgia, Maryland, North Carolina, South Carolina, Virginia, West Virginia; MidAtlantic includes New Jersey, New York, Pennsylvania; New England includes Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont

Figure 4.1. Study period made up of wash-out period, treatment windows, and outcome window.

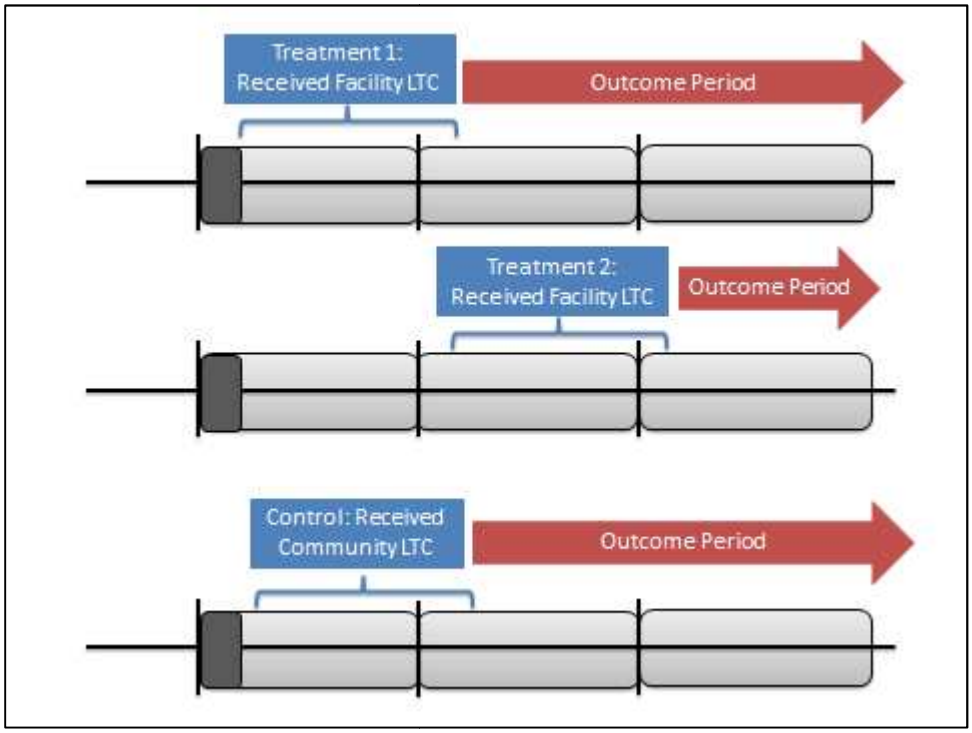


Figure 4.2. Incident facility LTC effect on survival.

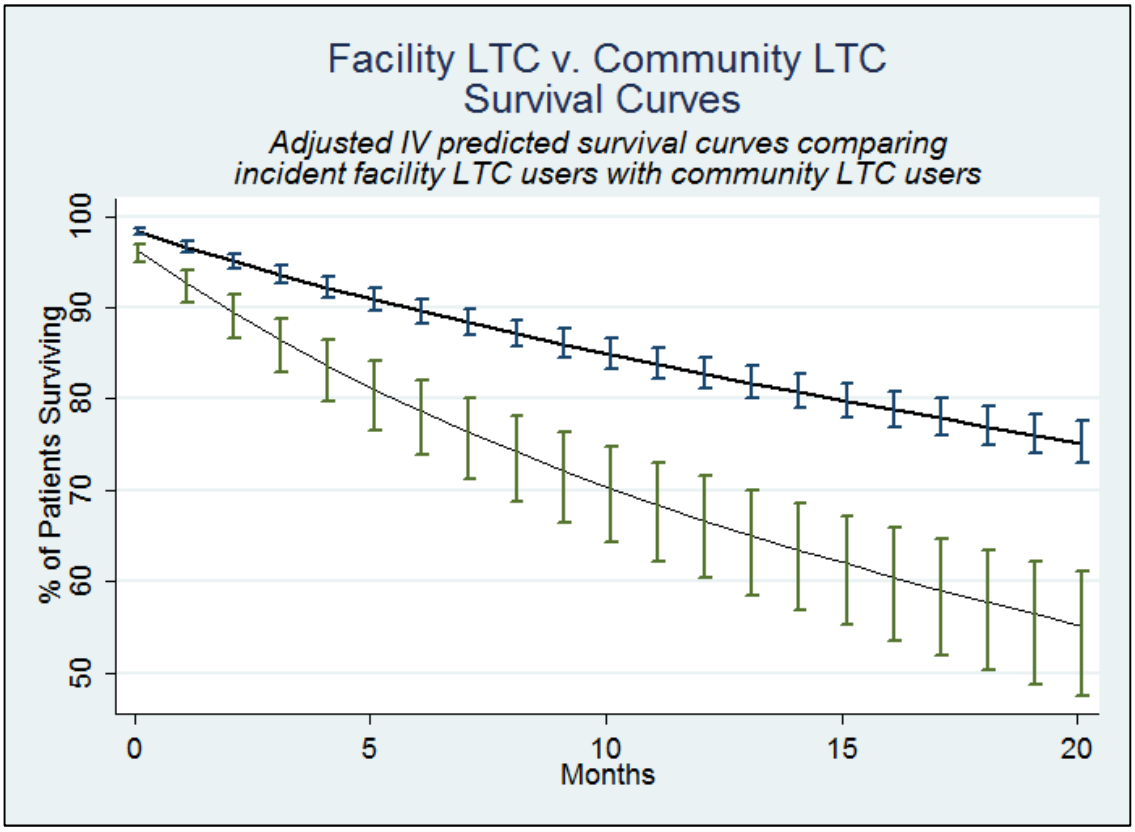


Figure 4.3. Incident facility LTC's differential effect (facility LTC vs. community LTC) on Medicare expenditures for inpatient services.

Positive values reflect higher expenditures for facility LTC users relative to community LTC users.

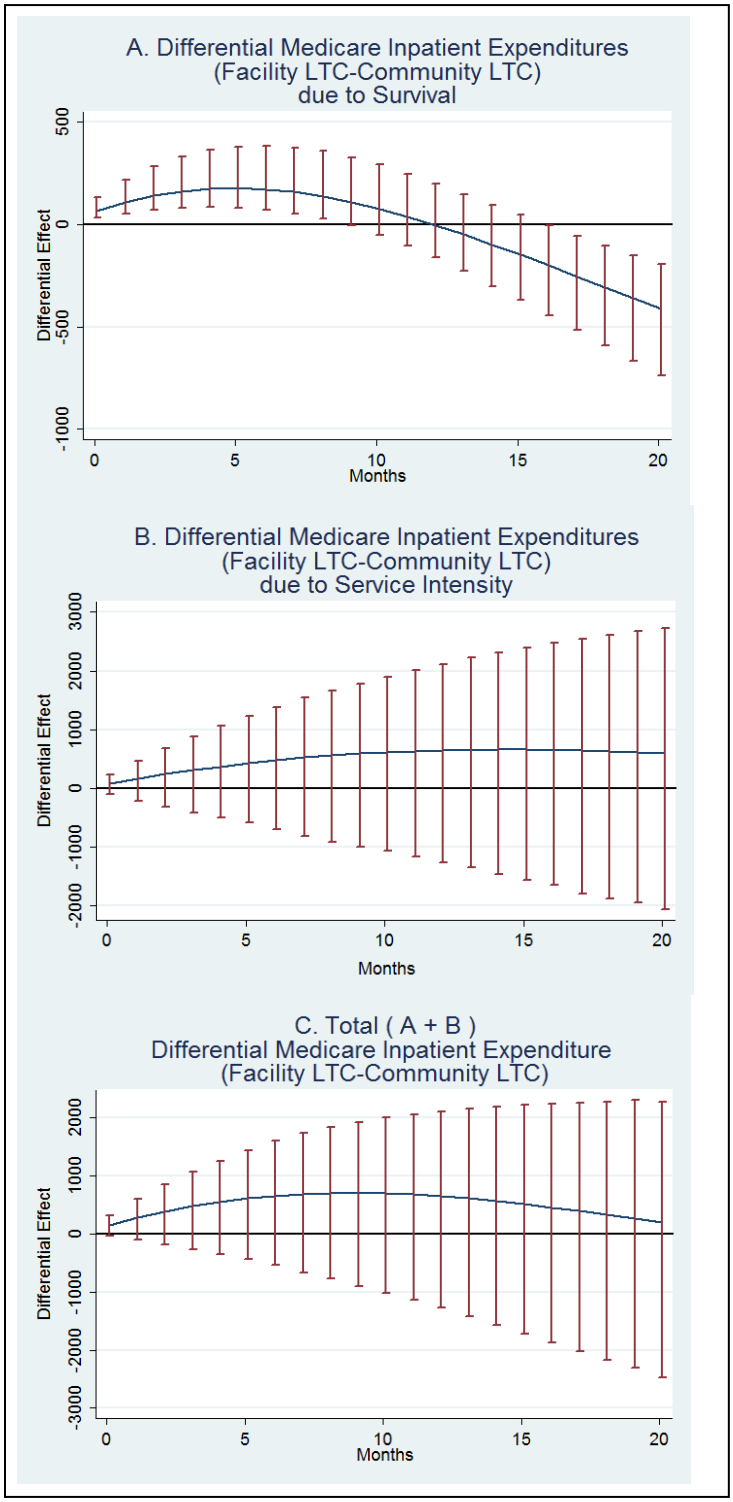
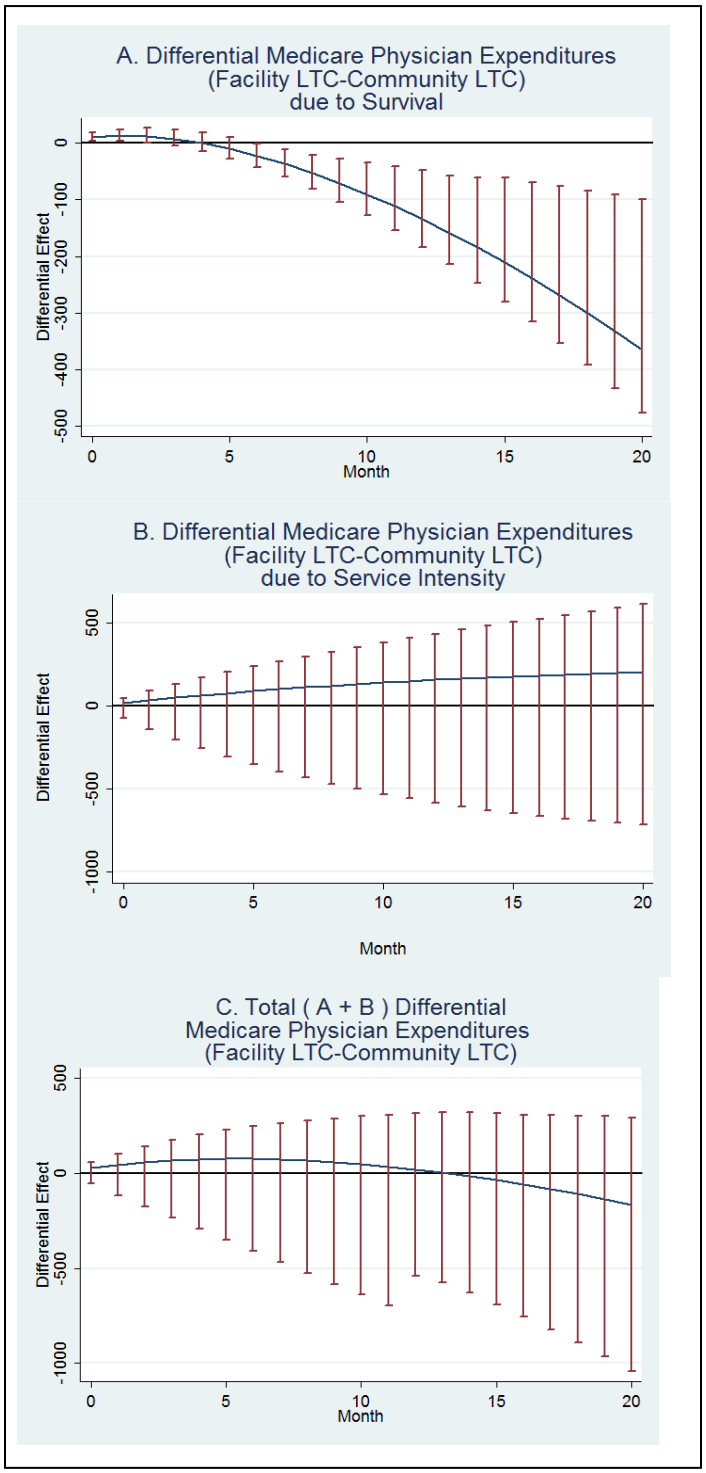


Figure 4.4. Incident facility LTC's differential effect (facility LTC vs. community LTC) on Medicare expenditures for physician services.

Positive values reflect higher expenditures for facility LTC users relative to community LTC users.



CHAPTER 5. AIM 2

5.1. Introduction

Medicare spending on sub-acute care, or nursing, rehabilitative, and similar services delivered outside acute-care hospitals, totaled approximately $60 billion in 2010.[123] These services, including skilled nursing facility (SNF), home health, and hospice, are drivers of the increased healthcare expenditures among high-cost patients.[124,125,126] Older, disabled Medicare beneficiaries are one such high-cost group.[127,128,129,130,131,132]

In addition to sub-acute services, disabled older adults use long-term care (LTC) that assists them with activities of daily living (ADLs), such as bathing, eating, and dressing. LTC can be delivered in facilities, such as nursing facilities (NF) or assisted living facilities (ALF), or the community. LTC providers have frequent, often daily, contact with care recipients; this frequent contact translates to influence over residents' healthcare use. Given this influence and continued concerns over growth in Medicare sub-acute spending, it is important for policymakers to better understand the relationship between LTC setting and sub-acute care.

Perhaps crucial to this understanding is that current Medicare and Medicaid reimbursement policies create financial incentives for LTC facilities to increase one type of sub-acute care, skilled nursing facility (SNF) rehabilitative care. The Medicare SNF benefit entitles beneficiaries to up to 100 days of Medicare-covered rehabilitative care in an SNF after hospitalizations (see Table 5.1). For NFs, the incentive to increase SNF care arises because the overwhelming majority of NFs provide both traditional LTC and SNF services. Though a single NF facility provides both SNF and LTC within the same building, these services differ in their primary goals (SNF care focused on improvement of functional status and health, LTC on maintenance) and staff skill level required. They also differ in the primary payer (Medicare covers SNF and Medicaid and private dollars pay for LTC). In the past twenty years, fiscal pressure on state Medicaid LTC budgets and resulting LTC payment cuts have pushed NFs to seek the substantially higher profit margins available for Medicare SNF services

relative to Medicaid and private-pay LTC.[133,134,135,136] The higher profit margin for SNF care provided NFs with an incentive to increase SNF services for beneficiaries who live in and receive LTC from NFs. Although ALFs do not provide SNF care directly, they face similar incentives to encourage SNF use by their residents. ALFs usually require residents to continue payments if they are hospitalized or admitted to SNFs; when this occurs, ALFs receive payment but provide no services.

Most research on the effects of LTC setting (facility versus community) to Medicare spending was conducted before the rapid growth in Medicare sub-acute care spending in the 1990s. For example, the Channeling Demonstration found no effect of delaying NF admission on Medicare costs in the 1980s.[137] Informal care, one type of community LTC, was shown to reduce Medicare expenditures for SNF and home health in the early 1990s.[138] Currently, Medicare and Medicaid policymakers are implementing changes to both the sub-acute market (e.g., bundling payments to providers) and LTC (e.g., increasing access to Medicaid-paid home and community-based services); therefore, updated evidence on the relationship between facility LTC and sub-acute service use is needed to inform policy on benefit structures and payment mechanisms.

This study compared facility LTC versus community LTC's effect on Medicare expenditures for certain sub-acute services—SNF, hospice, and home health—among older Medicare beneficiaries with disabilities from 2000–2009. We included certain sub-acute services in addition to SNF care because the Medicare cost implications of the SNF incentives could be negated if community LTC recipients are substituting other sub-acute services for SNF care. Alternatives for SNF care for patients needing skilled services outside an acute-care hospital setting include home health and hospice. These largely community-based sub-acute services have different eligibility criteria but can act as substitutes for one another or for SNF care for some patients (see Table 5.1). These three types of sub-acute services (SNF, hospice, and home health) are also among the largest segments of Medicare spending.[139] Due to the incentives discussed earlier, we hypothesized that individuals receiving facility LTC would have higher Medicare expenditures for sub-acute care than those receiving community LTC.

5.2. Methods

The high mortality among disabled older adults and the use of sub-acute services at the end-of-life[140,141] required an approach that could illuminate whether LTC setting affects healthcare use through mortality risks, which could increase or decrease healthcare use. Additionally, community and facility LTC users may have unobservable characteristics that affect their sub-acute healthcare use (e.g., patient acuity). To address these issues, we tested our hypothesis using an instrumental variables (IV) approach within a survival-adjusted model.

Survival-Adjusted Model Construction

Survival-adjusted methods allow us to estimate a total effect of facility LTC on sub-acute expenditures, composed of partial effects due to either survival differences or the rates of cost-accumulation when alive ("service intensity"). To do this, we estimated three different models as a function of treatment (t) and a vector of other covariates (x): (1) a survival model for all person-periods in which the beneficiary survived and was not censored estimated using discrete-time survival methods and a probit model, which generated a hazard function for death $\hat{\mathrm{h}}_{\mathrm{j}}(\mathrm{t},\mathrm{x})$ and the predicted probability of survival $\hat{\mathrm{S}}_{\mathrm{j}}(\mathrm{t},\mathrm{x})$; (2) a generalized linear model predicting expenditures $\hat{\mu}_{1\mathrm{j}}(\mathrm{t},\mathrm{x})$ conditional on death in the period; and (3) a generalized linear model estimating expenditures $\hat{\mu}_{2\mathrm{j}}(\mathrm{t},\mathrm{x})$ conditional on survival in the period. A modified Park Test identified the correct family in the generalized linear models.

In the survival-adjusted model, the estimated Medicare expenditures in a given period for any individual was the weighted sum of the expenditures conditional on survival to that period and death in that period or $\hat{\mu}_{\mathrm{j}} = \hat{\mathrm{S}}_{\mathrm{j}}(\mathrm{X}) * \left[\hat{\mathrm{h}}_{\mathrm{j}}(\mathrm{X}) * \hat{\mu}_{1\mathrm{j}}(\mathrm{X}) + (1 - \hat{\mathrm{h}}_{\mathrm{j}}(\mathrm{X}) * \hat{\mu}_{2\mathrm{j}}(\mathrm{X}))\right]$ with the total estimated expenditure over the period $\hat{\mu}(X)$ as the sum of the period-specific estimate. The marginal effect of a covariate X (such as facility LTC) on $\hat{\mu}_{\mathrm{j}}$ can be viewed as the total treatment effect (below) or, as mentioned, it can be decomposed into an effect on expenditures due to survival differences (first curly bracket below) and an effect on expenditures due to service intensity (second curly bracket):

$$\partial\hat{\mu}/\partial \mathrm{T} = \sum_{\mathrm{j}=1}^{\mathrm{K}} \left[\left\{ \frac{\partial \hat{\mathrm{S}}_{\mathrm{j}}(\mathrm{X})}{\partial \mathrm{X}} \left[\hat{\mathrm{h}}_{\mathrm{j}}(\mathrm{X}) * \hat{\mu}_{1\mathrm{j}}(\mathrm{X}) + (1 - \hat{\mathrm{h}}_{\mathrm{j}}(\mathrm{X}) * (\hat{\mu}_{2\mathrm{j}}(\mathrm{X})) \right] + \hat{\mathrm{S}}_{\mathrm{j}}(\mathrm{X}) * \left[\frac{\partial \hat{\mathrm{h}}_{\mathrm{j}}(\mathrm{X})}{\partial \mathrm{X}} \left(\hat{\mu}_{1\mathrm{j}}(\mathrm{X}) - \hat{\mu}_{2\mathrm{j}}(\mathrm{X}) \right) \right] \right\} \right.$$

$$\left. + \left\{ \hat{\mathrm{S}}_{\mathrm{j}}(\mathrm{X}) \left[\hat{\mathrm{h}}_{\mathrm{j}}(\mathrm{X}) * \frac{\partial \hat{\mu}_{1\mathrm{j}}(\mathrm{X})}{\partial \mathrm{X}} + \left(1 - \hat{\mathrm{h}}_{\mathrm{j}}(\mathrm{X})\right) * \frac{\partial \hat{\mu}_{2\mathrm{j}}(\mathrm{X})}{\partial \mathrm{X}} \right] \right\} \right]$$

Greater detail on the survival-adjusted model construction can be found at Basu & Manning[142] and Federspiel et al[143]. Marginal effects were bootstrapped using 5,000 replications to generate confidence intervals (CI).

Implementing Instrumental Variables

To account for possible unobservable differences between incident facility LTC and community LTC users that could bias estimates, we used an IV approach. This required us to identify covariates that would predict treatment but not the outcome of interest (sub-acute expenditures) after controlling for observable characteristics. Based on previous literature, our proposed instruments include the number of adult children,[144,145] local supply of LTC facilities, and state funding for home-delivered meals.[146]

The first-stage model was run as a probit model predicting incident use of facility LTC ($\mathrm{FLTC}_{\mathrm{jt}}$) as a function of the instrument and X, a vector of the predisposing, enabling, and need characteristics in Table 5.2.

$$\widehat{\mathrm{FLTC}}_{\mathrm{jt}} = \beta_0 + \beta_1 * \mathrm{Instruments}_{\mathrm{jt}} + \beta_2 * \mathrm{X}_{\mathrm{jt}} + \varepsilon_{1\mathrm{jt}}$$

The three second-stage models estimated either survival or sub-acute expenditures. Due to non-linear second-stage models, implementing the IV model required a two-stage residual inclusion (2SRI) approach.[147] In 2SRI, residuals from the first stage are included with the treatment and other predisposing, enabling, and need characteristics (X). Our 2SRI-based strategy deviated from the typical approach of 2SRI in two ways. First, we used the residual from the probit space rather than the probability space, more analogous to the inverse Mills ratio in a classic Heckman model.[148] Second, due to collinearity between the residual and the covariates (mean variance inflation factor >10), we simulated the residual by conducting multiple replications with a random draw from the standard normal distribution consistent with the parameter estimates (see Appendix 2).

Data Sources

Information about individuals, their use of facility or community LTC, and their sub-acute Medicare expenditures came from the 2000–2009 Medicare Current Beneficiary Survey (MCBS).[149] LTC supply came from the U.S. Census ZIP Code Business Patterns, which provided zip code–level counts of continuing care retirement communities (CCRCs), ALFs, and NFs.[150] Data derived from the 2000–2009 State Program Reports provided state-level spending on home-delivered meals funded through Title III-C2 of the Older Americans Act of 1965, which we translated into per capita amounts for the over 65 population.[151] Medicaid payment rates for NFs and percent of Medicaid spending on home and community-based services (HCBS) came from the Brown University LTCFocus Web site. Using these sources, we constructed an analytic file with person-month combinations. Each observation included an indicator of censoring (due to the end of their survey panel, death, or HMO enrollment) and an indicator of death in the month.

Sample Construction and Treatment

The retrospective study period was designed to have three periods: (1) a wash-out period covering an individual's first three months in the survey, or January 1 to March 31 of Year 1, during which eligible individuals had no facility LTC use; (2) a treatment window (April 1 Year 1 to March 31, Year 2) during which incident facility LTC or community LTC alone could occur. We included a second potential treatment window (April 1, Year 2, to March 31, Year 3) for those who were eligible for but did not use facility LTC during the first treatment window; and (3) an outcome period, split into calendar months, starting at the end of an individual's treatment window and continuing for a maximum 21 months.

As discussed, the sampling frame included individuals who entered the MCBS living in the community and did not use facility LTC during the wash-out period, with a few additional exclusion criteria. We excluded individuals who either were under the age of 50, entered a mental health or psychiatric center or residence for the care of the mentally retarded/developmentally disabled at any point, had missing information on the number of adult children, or if they lived in Puerto Rico.

Treatment was defined as incident LTC facility use (moving into an LTC facility) during the treatment period and included a non-Medicare–paid stay in a NF or any stay in an ALF. Assisted

living, board & care homes, domiciliary care facility, personal care facilities, rest homes, and adult/group homes were all considered ALFs. A Medicare-paid SNF stay alone, without private or Medicaid-paid facility LTC use, did not constitute treatment. Eligible controls were selected from those who received community LTC during the first treatment window and never went on to have a Medicaid or private-pay LTC facility stay. Community controls were age-matched to facility LTC users within three-year age-bins at a 3:1 ratio.

Measures

Outcomes: Dependent variables included survival and Medicare expenditures on SNF, home health, and hospice in each calendar month. Survival was constructed from MCBS data, which provided the end date of the month in which death occurred. Expenditures were calculated from claims. The sum of Medicare expenditures on SNF, home health, and hospice were aggregated for each calendar month. We divided claims that spanned more than one month by the proportion of days that occurred within that month. Claims that began after death were assumed to be errors and excluded from analyses. Expenditures were converted to 2004 real dollars using the medical consumer price index.[152]

Instruments: Number of adult children was self-reported from the fall prior to the treatment window. Number of CCRCs and ALFs were zip code–level counts. State-level spending on the Older Americans Act home-delivered meals was translated to per capita amounts for the over-65 population.

Covariates: Key predisposing, enabling, and need factors[153] were taken from the fall prior to the treatment window. These included LTC supply, demographic characteristics, geographic groups including census region and rurality using zip code–assigned RUCA codes, self-reported diagnoses, a measure of cognitive limitation from survey responses, and ADLs (see Table 5.2 for full list).

5.3. Results

Of the 3,330 beneficiaries in the sample, 26% were incident facility LTC users and 74% used only community LTC. The average participant was an 82-year-old unmarried white female with a high school education (Table 5.2). Despite age-matching, community LTC users had higher rates of many

cardiovascular diseases (p<.05) whereas facility LTC users had higher rates of Alzheimer's disease (p<.05). Surprisingly, community LTC users had more limitations in ADLs than facility users (p<.05).

Tests of Instruments and Endogeneity

Number of adult children was the only instrument to meet the test of strength (F statistic >10) in the first stage (F=14.77). All further tests were implemented using this instrument. Following a Modified Park test to identify the correct distribution family for the generalized linear model, both second-stage expenditure models were run as generalized linear models with a log link and Poisson family. We conducted a range of different tests of endogeneity for each of the three second-stage models, including a bivariate probit for the survival model and variations of the Hausman test, in which we ran the IV models as two-stage predictor substitution and linear probability models. We found no evidence of selection effects impacting the survival model but found mixed evidence for selection effects in the two expenditure models. Due to the mixed findings around selection, we implemented all models as 2SRI IV models.

Impact of Treatment on Survival

Incident facility use had a large and significant effect on cumulative survival during the outcome period (Figure 5.1). By month 20, incident facility LTC users had a cumulative survival rate of 55.2% (95% CI: 47.4%–61.2%) compared to 75.2% (95% CI: 73.0%–77.5%) among community LTC users (Figure 5.1). Estimates varied only slightly in the IV and non-IV models, suggesting that selection effects had little impact on survival (which was confirmed in multiple tests).

Effect of Facility LTC on Medicare Sub-acute Expenditures

There was a significant total marginal effect of facility LTC on sub-acute expenditures (see Figure 5.2), though the statistical significance of the effect disappeared in month 7 (cumulative effect on expenditures was $678 in month 6 with a bias-corrected 95% CI of $12–$1,317). This significant total increase in early months was largely due to increased intensity of service use when individuals were alive. The cumulative effect of facility LTC on service intensity was $2,833 (bias-corrected 95% CI of $408–$4,991) by month 21. However, the higher mortality among facility LTC users decreased expenditures significantly (-$1,083 cumulative effect in month 21), because individuals were more likely to have died as time passed and savings accrued. The combination of these countervailing

effects of facility LTC (increasing service intensity when alive but higher mortality inadvertently saving money as time passes) resulted in the non-significant total marginal effect in later months.

5.4. Discussion

We examined whether facility LTC use increased Medicare expenditures for certain sub-acute services (SNF, hospice, and home health) for one group of high-cost Medicare beneficiaries—disabled older adults. Our findings suggest that incident facility LTC increased Medicare expenditures on these sub-acute services relative to community LTC, although these higher expenditures were mediated by higher mortality in LTC facility users (which reduced costs over time). These findings are consistent with Van Houtven and Norton's findings that one type of community LTC, informal caregiving, reduced home health and SNF use.[154] However, our findings also provide insights into the pathways through which facility LTC affects expenditures: intensity of sub-acute use and survival effects.

Our findings suggest that facility LTC increased sub-acute service intensity when residents were alive. This increase may have resulted from current financial incentives regarding reimbursement (higher margins on SNF versus LTC among NFs; lower costs of care for ALFs while patients are receiving SNF care). Alternatively, our findings may be tied to the construction of benefits and facility LTC users' home health and hospice use. For example, NF residents can only receive rehabilitative care from more expensive SNFs because Medicare benefits do not allow home health agencies to deliver services to NF residents (and hospice benefits do not cover rehabilitation). Additionally, although hospice use in NFs is increasing, NF residents are more likely to use SNF benefits instead of hospice at the end-of-life.[155] This may also be due to benefit construction. Hospice benefits do not cover NF room and board, whereas the Medicare SNF benefit does. Thus, permanent NF residents receiving hospice have to pay out-of-pocket or have Medicaid pay their room and board, whereas those receiving SNF have Medicare cover their room and board. As a result, Medicare beneficiaries living in a NF may prefer to receive the SNF benefits over hospice.

We also found that facility LTC increased mortality, which decreased cumulative expenditures on sub-acute care over the outcome period. This higher mortality among facility LTC users began to offset increased expenditures due to service intensity, rendering a non-significant total effect on

Medicare expenditures in later months. To date, most work suggesting facility LTC increases mortality has been observational and attributed largely to increased frailty in this population,[156,157,158] although at least one study found some independent effect of NF use on survival.[159] The use of an IV suggests at least some causal relationship between incident facility LTC and increased mortality. Recent research has shown that facility LTC residents have a higher number of transitions from hospital and SNF compared to community residents, though this work did not account for selection effects.[160] If facility LTC increases the number of transitions (which would be consistent with the higher expenditures found here), it may be that transitions create more opportunities for failures in care coordination and a risk for poor outcomes, including mortality.[161] Additional research is needed to discover the reasons for the higher mortality and what role, if any, higher use of sub-acute care played in higher mortality for facility LTC recipients.

Limitations

We note several limitations. First, there may be differences in unobserved characteristics between community LTC and facility LTC users. The use of IV should address some of these concerns. However, because the IV was exactly identified, we were unable to test whether the instrument fails the exclusion restriction. Fortunately, number of adult children has been shown to be a valid instrument among older adults (those using LTC).[162] Second, we did not use sampling weights due to complexities of the modeling effort and the longitudinal sample construction from multiple waves of the MCBS. Thus, the analysis presented here may not be nationally generalizable.[163] Third, the sub-acute services modeled here (SNF, home health, hospice) can act as substitutes for certain patients but have important differences among them and their potential patient populations. To address these concerns, we ran a sensitivity analysis of estimating only SNF services as the dependent variable and inferences remained the same, suggesting that the effect of facility LTC lies primarily with use of SNF services. Finally, we did not include services such as long-term acute care hospitals or inpatient rehab facilities in the dependent variable. Because these services generally serve a small subset of complex patients with highly acute needs, the degree to which these services are substitutable for SNF, hospice, and home health, the highest cost-growth sub-acute care areas,[164] is limited among the general older disabled population.

Implications for Policy and Practice

Our findings should be useful to policymakers as they structure new payment mechanisms that target facility LTC residents. In particular, payment reforms currently being implemented in the ACA seek to control Medicare sub-acute expenditures by improving care coordination. For example, the Bundled Payments for Care Improvement Initiative strives to integrate providers across the Medicare spectrum (including many sub-acute providers) through payments for episodes of care. Evaluations of these initiatives should examine their effectiveness for patients in LTC facilities, because our findings suggest that these beneficiaries have higher sub-acute costs. Most NFs provide both skilled and residential LTC but serve a minority of Medicare SNF patients relative to overall patient mix; a small subset of NFs serve a much higher proportion of SNF patients relative to overall patient days and these tend to be for-profit and/or hospital-based.[165] If most NF providers are providing relatively little SNF care and, as a result, are less affected by bundled payment incentives, bundling payments may not impact sub-acute expenditures for the broader facility LTC population.

Our findings may also have implications for improving benefit designs so that disabled beneficiaries are matched with appropriate but less costly sub-acute care. Given our findings, LTC facility residents are appropriate targets for these efforts. It is acknowledged that, in addition to incentives to increase SNF use, incentives exist for long hospice stays for NF residents, which may or may not be appropriate.[166] Interest in financing a new hospice benefit for NF residents that includes a bundled payment for all post-acute, hospice, and long-term care could be part of an effort to incentivize providers to match patients with the appropriate sub-acute care.[167] If LTC facilities and beneficiaries could gain by substituting appropriate hospice care for SNF care, and do so at a lower cost than SNF care, new NF-specific hospice benefit designs could decrease total Medicare expenditures. Another way to achieve this goal is through general efforts to incentivize healthcare providers (including LTC) to integrate LTC and healthcare delivery. Payment reforms to accomplish this, including changes to the physician fee schedule (to incentivize care coordination efforts) or federalizing all benefits for dual eligibles, could enable their success. These may help match necessary sub-acute care to the right patient.

Finally, policies to increase Medicaid-financed home and community-based services (HCBS) should consider their impact on Medicare sub-acute expenditures. Recent research on dual eligibles suggests that hospitalization rates may rise when individuals are transferred to the community.[168] Our study broadens the lens to consider the impact of HCBS expansion on mortality and certain sub-acute service use. If indeed there are potential savings for Medicare that could result from shifting Medicaid funding toward HCBS, CMS should consider overall Medicaid and Medicare costs and the exploding sub-acute expenditures in the calculus of access to community-based LTC. Regardless of its exact form, continued integration of LTC and health care should be a focus for Medicare cost containment among the LTC population.

Table 5.1.

Medicare Sub-Acute Benefits

Medicare Benefit	**Eligibility Restrictions**	**Services Covered**	**Covered for NF residents?**	**Covered for ALF Residents?**
Skilled Nursing Facility	Patients in need of skilled nursing or rehabilitative care within 30 days of a 3-day inpatient stay	skilled nursing, physical therapy, speech-language pathology, occupational therapy, medications, dietary counseling, and medical social services	Yes	Yes
Home Health	home bound individuals who need skilled care on a part-time basis (skilled nursing care that's needed or given on fewer than 7 days each week or less than 8 hours each day over a period of 21 days or less)	skilled nursing, home health aide, physical therapy, speech-language pathology, occupational therapy, and medical social services	No	Yes, though with important anti-kickback provisions
Hospice	certified as having six or less months to live	All services related to terminal illness, but not room and board	Yes	Yes

Table 5.2.

Descriptive Statistics for Sample of LTC Users by Setting of LTC

	Community (N=2,466)	Facility (N=864)
LTC Supply Interest	**Mean (SD) or Percentage**	
Number Children***	3.0 (2.3)	2.5 (2.1)
Assisted Living Facilities	1.2 (1.9)	1.2 (1.8)
CCRCs	0.4 (0.7)	0.4 (0.8)
State Spending Delivered Meals	5.2 (2.0)	5.2 (2.1)
State Medicaid NF Per Diem	149.3 (34.8)	150.5 (34.0)
% Medicaid Spending on HCBS	25.3 (13.4)	24.3 (13.2)
Enabling Characteristics	**Mean (SD) or Percentage**	
Education*		
Less than High School	48.8%	44.3%
Some College	42.6%	45.1%
College Graduate	8.6%	10.5%
Census Regions***		
Mountain	6.5%	4.9%
Pacific	10.6%	8.9%
South Atlantic	22.4%	19.3%
West South Central	10.9%	11.3%
East South Central	9.3%	7.3%
West North Central	7.2%	10.3%
East North Central	15.0%	20.1%
MidAtlantic	15.7%	15.0%
New England	2.3%	2.8%
Rural		
Urban	70.9%	68.6%
Large Town	16.4%	16.7%
Rural	12.7%	14.7%
Any Medicaid Eligibility***	25.6%	19.3%

	Community (N=2,466)	Facility (N=864)
Pre-disposing Characteristics	**Mean (SD) or Percentage**	
Age	82.3 (8.4)	82.3 (8.5)
Married***	43.1%	28.9%
Female	67.9%	67.1%
African American***	13.6%	9%
Need Characteristics	**Mean (SD) or Percentage**	
Functional Limitation		
Number of ADLs ***	2.4 (1.8)	1.7 (1.8)
Cognitive Limitation	34.1%	34.4%
Health Conditions		
Alzheimers**	11.1%	14.9%
Hip Fracture**	11.6%	8.2%
Diabetes*	26.0%	22.5%
Cancer	18.0%	17.2%
COPD/Emphysema**	17.6%	13.0%
Stroke*	26.5%	22.3%
MI	17.8%	17.5%
CHF	8.8%	7.9%
Arteriosclerosis*	13.8%	10.6%
Arhythmia	13.7%	13.1%
Angina***	14.4%	9.5%
Hypertension**	64.3%	58.6%

West includes Alaska, California, Hawaii, Oregon, Washington; Mountain includes Arizona, Colorado, Idaho, Montana, Nevada, New Mexico, Utah, Wyoming; West South Central includes Arkansas, Louisiana, Oklahoma, Texas; East South Central includes Alabama, Kentucky, Mississippi, Tennessee; West North Central includes Iowa, Kansas, Minnesota, Missouri, Nebraska, North Dakota, South Dakota; East North Central includes Illinois, Indiana, Michigan, Ohio, Wisconsin; South Atlantic includes Delaware, District of Columbia, Florida, Georgia, Maryland, North Carolina, South Carolina, Virginia, West Virginia; MidAtlantic includes New Jersey, New York, Pennsylvania; New England includes Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont

Figure 5.1. Incident facility LTC effect on survival.

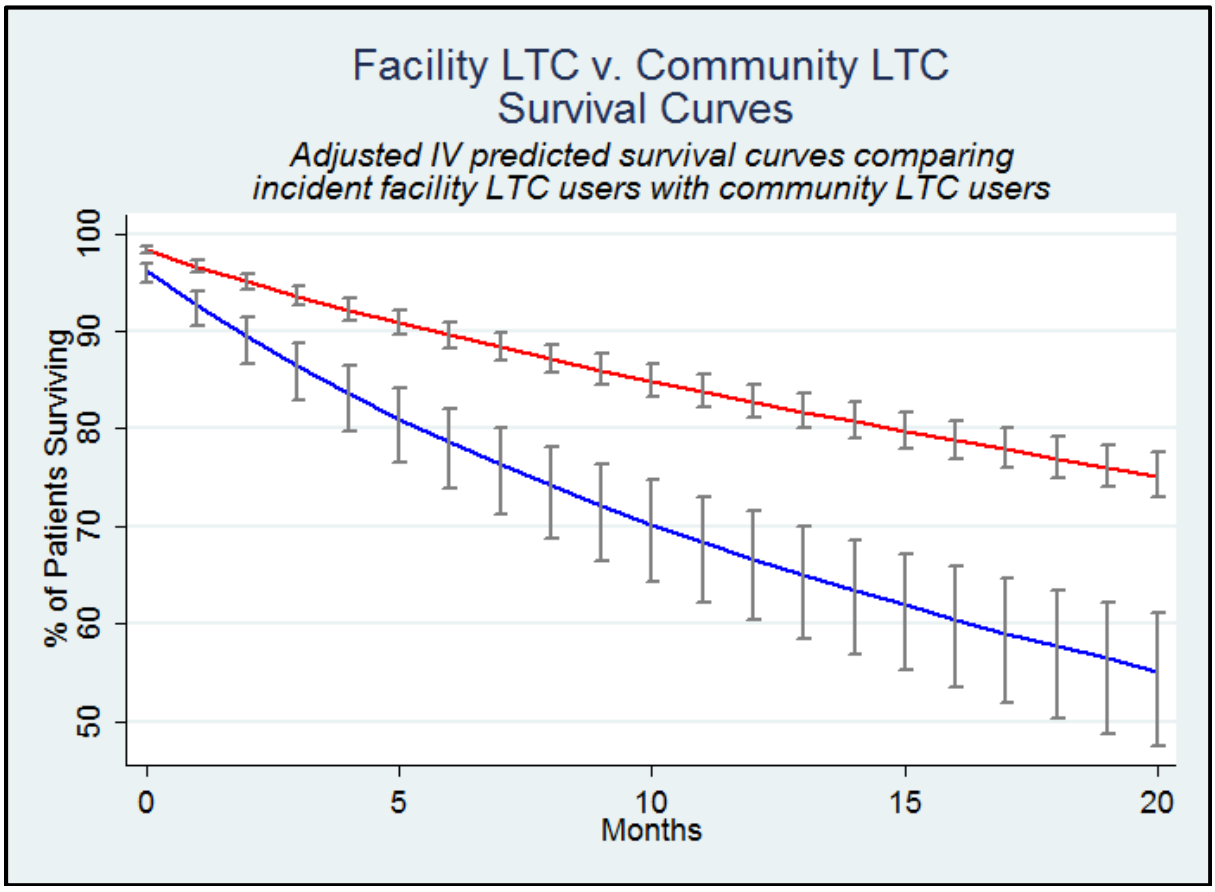
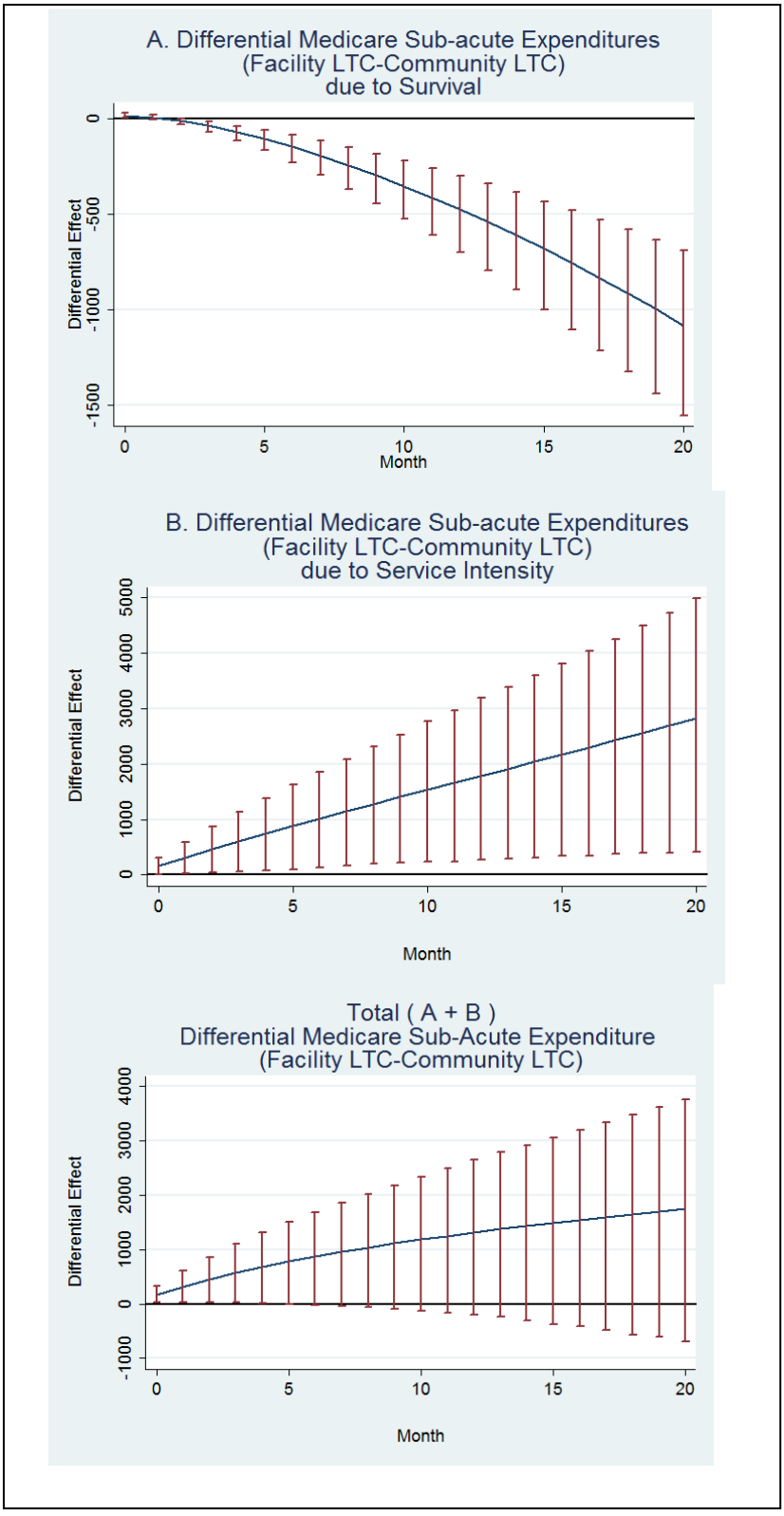


Figure 5.2. Incident facility LTC's differential effect on Medicare sub-acute expenditures.



CHAPTER 6. AIM 3

6.1. Introduction

Hospital readmissions are costly to Medicare and may be an indicator of poor quality care during the hospital stay, at discharge, or post-discharge.[169] As a result, hospital readmissions have become a central focus of Medicare cost containment and quality improvement efforts. Hospitalized disabled older adults are at increased risk of readmission.[170,171] This may be because individuals who need post-discharge long-term care (LTC) face different risk factors for readmission than individuals who do not need LTC. Failure to meet patients' LTC needs could exacerbate a fragile health state by creating a risk for falls, infections, or malnourishment.

Alternatively, a patient's post-discharge dependence on LTC providers may create other risks for readmission, because LTC providers may have their own financial and clinical motivations that influence subsequent admission decisions. LTC providers are largely paid or unpaid caregivers who help community-dwelling individuals with activities of daily living (ADLs), most often in patients' homes ("community LTC").[172] A minority of LTC providers are LTC facilities, including assisted living facilities (ALFs) or nursing facilities (NFs). Some research suggests that receiving facility LTC prior to hospital admission increases risk of hospital readmission. For example, observational research from 2006 showed that stays in an NF before a hospitalization increased the risk for subsequent readmission by approximately 3%.[173]

Possible explanations for the increased readmission risk among facility LTC residents are complex and multi-faceted. Facility LTC residents are likely frailer and older than the general population, which could complicate their care needs and risk for readmission regardless of LTC setting. However, there are several potential pathways through which facility LTC use might compound the general risk of readmission for frail, older adults. First, exposure to multiple settings of care and associated poor care coordination could contribute to readmission. Individuals living in LTC facilities, particularly NFs, report a low-touch relationship with physicians.[174,175] Additionally,

observational research suggests that NF residents are more likely to transition across multiple settings of care.[176] If no single provider manages the patient across settings of care (NF facility, hospital, and then post-hospital destination), this could create a risk of readmission.

Second, financial incentives for LTC facilities may increase risk of readmission for their residents. For example, qualitative research suggests liability is a major driver of hospitalizations from LTC facilities.[177] Additionally, financial incentives may shape LTC facility practice patterns around hospitalization. Many Medicaid programs pay NFs a per diem to hold beds when Medicaid-covered residents are hospitalized. When Medicaid bed-hold policies are in place, they increase readmission rates even for NF patients who are not eligible for the bed-hold payments due to "spillover effects" in NF hospitalization practices.[178] ALFs face similar incentives to increase hospital admissions and readmissions because they require continued rent during hospitalization.

Finally, readmissions for facility LTC residents may be related to patients' preferences. Individuals living in an NF before a hospitalization may want to return to the same NF for their rehabilitation care, regardless of whether that NF has expertise in the specific services they need. Though most NFs provide both post-hospital SNF rehabilitation care and LTC, there is variation in the mix of care NFs provide. Some NFs provide a majority of rehabilitation care (particularly hospital-based SNFs)[179] and patients discharged to SNFs that care primarily for rehabilitation patients tend to have lower rates of readmission.[180] If patients prefer to be discharged to their prior facility regardless of its experience in providing rehabilitation care, this may put prior facility LTC residents at greater risk of readmission.

To date, limited research has examined whether any increased risk in readmission among those in facility LTC is due to higher frailty and acuity alone or prior facility LTC use has an independent role in readmission risk. Given the financial implications of readmission to Medicare (and to providers and other payers as new payment programs are being implemented), we sought to examine whether facility LTC increased readmissions for Medicare beneficiaries from 2000 to 2009 relative to community LTC, controlling for clinical and unobservable characteristics.

6.2. Methods

Data Sources

Survey and claims data came from the 2000–2009 Medicare Current Beneficiary Survey (MCBS).[181] LTC supply came from the U.S. Census ZIP Code Business Patterns. Data derived from the 2000–2009 State Program Reports provided state-level spending on Title III-C2 of the Older Americans Act of 1965.[182] State-level funding of LTC came from the Brown University LTCFocus Web site.

Sample Construction

The study period for each individual in the data between 2000 and 2009 was divided into three periods: (1) wash-out period; (2) one-year treatment window during which individuals used either facility LTC or community LTC; and (3) outcome period, during which eligible discharges could occur. Because we sought to identify individuals at risk of facility LTC but who could use community LTC, the sampling frame of individuals included those who used no facility LTC during the wash-out period and then received either facility LTC or community LTC during the treatment window.

The sample was constructed with observations as discharges. Hospital admissions of 50-year-old and older beneficiaries that occurred during the outcome window for all treated (incident LTC facility use) and control (community LTC use) individuals, as defined in the next section, were eligible for inclusion. Each observation had indicators for either 30- or 60-day readmissions.

Measures

We defined both index admissions and readmissions using the Yale Hospital-Wide All-Cause Unplanned Readmission measure.[183] This used the AHRQ Clinical Classification Software grouping of ICD-9 codes. Index admissions that were eligible for a potential readmission included all discharges except direct transfers to other acute care hospitals, discharges against medical advice, cancer management treatment without a surgical procedure during the admission, psychiatric condition as the primary diagnosis, stays for rehabilitation fitting of prostheses and adjustment devices, or admissions in which the individual enrolled in an HMO or rolled off the MCBS survey within 30 or 60 days of the initial discharge.

Our primary outcome, hospital readmission, included all hospitalizations unless they either were planned or stays for cancer management treatment without a surgical procedure, psychiatric conditions, or rehabilitation fitting of prostheses and adjustment devices. We included separate indicators for readmissions that occurred within 30 or 60 days of discharge from the index admission.

We also included indicators on index admissions if an individual died within either the 30- or 60-day readmission window. Death was taken from proxy-reported death date. The MCBS also provides the Social Security Administration (SSA)–verified calendar month of death. In cases where the proxy-reported and SSA-verified month of death did not coincide, we conducted sensitivity tests by excluding these individuals.

The main exposure was LTC setting. We defined treatment as incident LTC facility use during the one-year treatment window. Incident LTC facility use included a non-Medicare paid stay in an NF or any stay in an ALF. Assisted living, board & care homes, domiciliary care facilities, personal care facilities, rest homes, and adult/group homes were all considered ALFs. A Medicare-paid SNF stay alone, without an accompanying private or Medicaid-paid facility LTC use, did not constitute treatment. Control discharges were selected from those who received community LTC during the first treatment window and never went on to receive facility LTC.

We identified covariates a priori (Table 6.1). LTC supply characteristics such as counts of ALFs and Continuing Care Retirement Communities (CCRC) in the individual's zip code and state-level funding for LTC were drawn from the year in which the treatment window began. Number of adult children and all other individual-level characteristics, including most pre-disposing, enabling, and need characteristics, were measured in the fall prior to the treatment window to limit endogeneity. We constructed the Charlson Comorbidity Index from the index admission's discharge data.[184]

Analytical Methods

Because individuals who use facility LTC may have unobservable characteristics that affect both LTC setting and risk of readmission (such as frailty, etc.), we used an instrumental variable (IV) approach to adjust for selection effects. Valid IVs should predict the treatment (facility versus community LTC) but not the outcome of interest (hospital readmission) after controlling for observable characteristics. Based on previous literature, we considered as potential IVs three LTC supply

measures: number of adult children,[185,186] local number of LTC facilities, and state funding for home-delivered meals[187]. After predicting treatment in a probit model, we included the residual from this first stage in the second-stage logistic regression predicting likelihood of readmission.[188] We bootstrapped our marginal effects, calculated using the method of recycled predictions, in 5,000 replications to generate confidence intervals (CI).

We conducted sensitivity tests to examine whether excluding those who died would bias our estimates. This involved one model in which we excluded those who died within 30 or 60 days respectively and one in which we ran a composite measure of likelihood of death or readmission within 30 or 60 days. We also tested whether including ALF and NF in one treatment was biasing estimates by running one model in which we excluded individuals who received facility LTC only in an ALF and did not go on to live in an NF. We also ran alternative models with non-ideal specifications, including the model run as a linear probability model and two-stage predictor substitution (2SPS), to test selection effects.

6.3. Results

The descriptive statistics for discharges (not persons) eligible for a 30-day readmission are presented in Table 6.1. Of the 2,704 admissions, 48 were censored within 30 days of discharge due to HMO enrollment or survey roll-off and 408 died within 30 days of discharge, leaving a sample of 2,248. The sample of 60-day readmissions is slightly smaller than the sample presented below due to greater censoring (HMO enrollment or death). The sample in Table 6.1 reflected some expected differences, with facility LTC users being older and less like to be married than community LTC users. However, the sample of community LTC users had an unexpectedly higher level of baseline disability.

Tests of Instruments and Selection

The number of adult children was the only instrument to pass tests of strength (F-test >10). In both the 30- and 60-day readmission models, the Hausman test on the residual failed to reject the null of exogeneity. In further sensitivity analyses, we ran readmission as bivariate probit models and found no evidence of selection (rho not significantly different from 0) and a non-significant effect of treatment on likelihood of 30-day or 60-day readmission. We also implemented the model as a 2SPS to test selection and inference and found no evidence of selection. However, given the study goals of

identifying the independent effect of facility LTC, we ran the models as IVs as the preferred approach to be conservative.

Effect of LTC Setting on Readmissions

In the IV models, previous incident facility LTC use had a non-significant differential effect on likelihood of either a 30-day readmission (bias-corrected 95% CI: -.16 to .60) (Figure 6.1) or a 60-day readmission (bias-corrected 95% CI: -.33 to .36) (Figure 6.2). The non-IV models also showed a non-significant differential effect on likelihood of a 30-day readmission and 60-day readmission. The results remained the same when conflicting reports of death date were excluded from the analysis. We ran a sensitivity test in which we modeled death and readmission as a composite dependent variable, but the effect of LTC setting remained non-significant. Finally, the effect of facility LTC remained non-significant when we excluded from the treatment group those who used only ALF care.

6.4. Discussion

Previous observational research suggested that setting of LTC affected the likelihood of hospitalizations and readmissions. An observational study of Medicare-covered SNF stays showed that NF residence before the index hospital admission increased the risk of hospital readmission.[189] Among those dually eligible for Medicare and Medicaid, potentially avoidable hospitalizations were higher among NF residents compared to community residents.[190] However, in another study in which propensity scores were used to create comparable groups among dual eligibles, community LTC increased the risk of hospitalization relative to NF residence, which researchers attributed to the difficulties of closely monitoring individuals in the community.[191] In contrast to either of these findings, our research found that previous LTC setting (facility versus community) did not affect readmission (Figure 6.3), neither in models that treat prior facility use as exogenous nor those that controlled for unobserved sources of endogeneity.

The differences between previous studies and ours could be explained by our controlling for the increased frailty or other unobservable differences associated with facility LTC use. If so, prior studies' reported differences in readmission may be attributable to unobserved differences among those who use community LTC versus NFs. Although our tests for selection effects were largely null, these tests are low powered and do not conclusively resolve whether selection effects were present.

As such, accounting for unobservable characteristics may still be important, although our non-IV models also showed non-significant effects of LTC setting. An alternative explanation for our findings is that prior facility LTC use occurred much before the index admission and thus had little impact on later readmission risk. The study design (including identification of a wash-out period and a priori treatment window) was intended to identify those at risk of facility LTC use and thus create as comparable a group of treated and controls as possible; however, it may be that facility LTC use occurred too far before the index admission, with more impactful experiences in the interim such as a health event that altered LTC need or change in living situation. Alternative study designs, such as looking at the LTC setting (community versus facility) immediately prior to the index admission, may suggest a greater role for LTC setting but would likely struggle to identify facility LTC users who could receive LTC in the community, the population most likely to be influenced by LTC policy-making.

Yet another alternative explanation for the difference in findings is that, in this population, readmission risk is more a function of the setting of care that someone is discharged *to*, rather than admitted *from*.[192, 193] That prior facility LTC did not affect readmission may suggest that heterogeneity in discharge destination in our sample was greater than we expected. We had imagined that previous LTC might affect discharge destination, which was a possible causal pathway through which previous facility LTC use increased risk of readmission. If (1) individuals previously in an NF are likely to desire to return to that NF for SNF care and (2) risk of readmission increases when individuals are discharged to facilities that provide less SNF care, then readmission risk would be compounded because facility LTC residents may be more likely to return to their previous NF, which may not have expertise in rehab care.[194] However, some community LTC users are likely using SNF rehabilitation care and some facility LTC users may be going to other facilities for rehab care after the index admission, which would dilute the influence of prior LTC facility residence and could explain the results presented here. Future research that investigates how prior LTC setting affects post-discharge destination and subsequent risk of readmission may be helpful to efforts to better understand the observed risk of readmission among LTC facility users.

Limitations

There are several limitations to our study. First, the relatively small sample size combined with our use of an IV reduced our power to detect differences. Second, because only one IV passed tests of strength, we were unable to fully test instrument validity, though number of adult children has been used in similar studies.[195] Third, the samples of community LTC and facility LTC users differed in unexpected ways, particularly the higher level of disability among community LTC users. This may reflect that incident facility LTC users experienced a sudden health crisis (hip fracture, etc.) that drove their facility LTC use. However, any bias resulting from unobservable changes in health status such as the hip fracture in the above example should be addressed by the use of IVs in this analysis. Finally, although ideally we would have been able to estimate the treatment effects on potentially avoidable readmissions,[196] the small sample size and already reduced power due to the use of IVs prevented us from further limitations to the sample and outcomes. However, we believe our results on all-cause readmissions are still informative for policymakers and providers.

Implications for Policy and Practice

In contrast to previous studies, we found that prior facility LTC residence may not independently *increase* risk of hospital readmission. This suggests that efforts to shift Medicaid budgets toward more proportional spending on community LTC (relative to facility LTC) may not impact readmission rates. However, LTC providers will remain important to the success of policy initiatives to *reduce* readmissions. Because they are part of both the LTC and the Medicare-covered sub-acute system and specifically targeted in new Medicare payment mechanisms (ACOs, bundles), facility LTC providers will be easier to influence through new Medicare incentives intended to reduce readmissions compared to the past. Important efforts at transparency will also enable the provider alignment necessary to meet these incentives. For example, efforts are underway to roll-out data sources that will make it easier for NFs and partnering providers to track NF readmissions, including the NF trade association's trend tracker[197] and CMS measures.[198] Even if these efforts are focused on Medicare rehabilitation patients in SNF stays, there could be positive spillover effects for long-stay NF residents.

On the other hand, community LTC providers, given their diversity and decentralized nature, will be harder to influence through new Medicare payment mechanisms. Because they are often unpaid family caregivers or sometimes a collection of many paid and unpaid caregivers, hospitals and other healthcare providers may struggle to integrate community LTC providers into systems intended to decrease readmissions. Providers looking to coordinate with community LTC teams should look to programs such as PACE, which works cooperatively with community LTC providers to coordinate care. Additionally, providers should look to tools developed for care transitions[199] or tools to reduce hospitalizations among similar patients in facility settings such as INTERACT,[200,201] which could be adapted to train community LTC providers. Researchers should investigate those systems and areas that successfully reduce readmissions and understand how each LTC provider (community and facility LTC) cooperated with other healthcare providers, seeking to highlight those initiatives and programs that successfully reduce readmissions.

Table 6.1.

Descriptive Statistics for Sample of Discharges by Previous Setting of LTC

	Mean (SD) or Percentage			Mean (SD) or Percentage	
LTC Supply Interest	**Community** (N=1,793)	**Facility** (N=455)	**Pre-disposing Characteristics**	**Community** (N=1,793)	**Facility** (N=455)
Number Children***	3.2 (2.3)	2.7 (2.2)	Age***	76.4 (10.3)	80 (9.5)
Assisted Living Facilities	1.1 (1.7)	1.1 (1.7)	Married***	47.3%	25.3%
CCRCs	0.3 (0.6)	0.3 (0.6)			
State Spending Delivered Meals	5.3 (2.4)	5.3 (2.4)	Female	66.1%	69.9%
State Medicaid NF Per Diem***	152.5 (36.1)	145.2 (33.2)	African American	13%	12.5%
% Medicaid Spending on HCBS**	25 (13.5)	23 (13.3)			
Potentially Enabling Characteristics	**Community** (N=1,793)	**Facility** (N=455)	**Need Characteristics**	**Community** (N=1,793)	**Facility** (N=455)
Education*			Functional Limitation		
Less than High School	46.8%	53.4%	Number of ADLs ***	2.6 (1.9)	2.1 (2)
Some College	45.7%	38.2%	Cognitive Limitation	31.3%	31.4%
College Graduate	7.5%	8.4%	Health Conditions		
Census Regions*			Alzheimers*	7%	10.5%
New England	2.5%	2.2%	Hip Fracture	8.5%	9.5%
Mid-Atlantic	15.8%	16.9%	Diabetes	38.3%	35.2%
E. North Central	14.7%	18.7%	Cancer***	20%	12.5%
W. North Central	6.9%	11.4%	COPD/Emphysema***	25.9%	18.5%
South Atlantic	22.6%	20%	Stroke	26.9%	27%
E. South Central	9.9%	7.7%	MI	24.8%	20.7%
W. South Central	13.8%	11.4%	CHF**	11.9%	6.8%
Mountain	5.4%	4.4%	Arteriosclerosis**	16.3%	11.2%
Pacific	8.3%	7.3%	Arhythmia	16.3%	13.2%
Rural			Angina**	17.5%	12.3%
Urban	67.5%	71.4%	Hypertension**	68.3%	60.7%
Large Town	18.3%	15.2%			
Rural	14.2%	13.4%			
Any Medicaid Eligibility	30.3%	28.1%			

West includes Alaska, California, Hawaii, Oregon, Washington; Mountain includes Arizona, Colorado, Idaho, Montana, Nevada, New Mexico, Utah, Wyoming; West South Central includes Arkansas, Louisiana, Oklahoma, Texas; East South Central includes Alabama, Kentucky, Mississippi, Tennessee; West North Central includes Iowa, Kansas, Minnesota, Missouri, Nebraska, North Dakota, South Dakota; East North Central includes Illinois, Indiana, Michigan, Ohio, Wisconsin; South Atlantic includes Delaware, District of Columbia, Florida, Georgia, Maryland, North Carolina, South Carolina, Virginia, West Virginia; MidAtlantic includes New Jersey, New York, Pennsylvania; New England includes Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont

Figure 6.1. Facility LTC's incremental effect on likelihood of 30-day readmission.

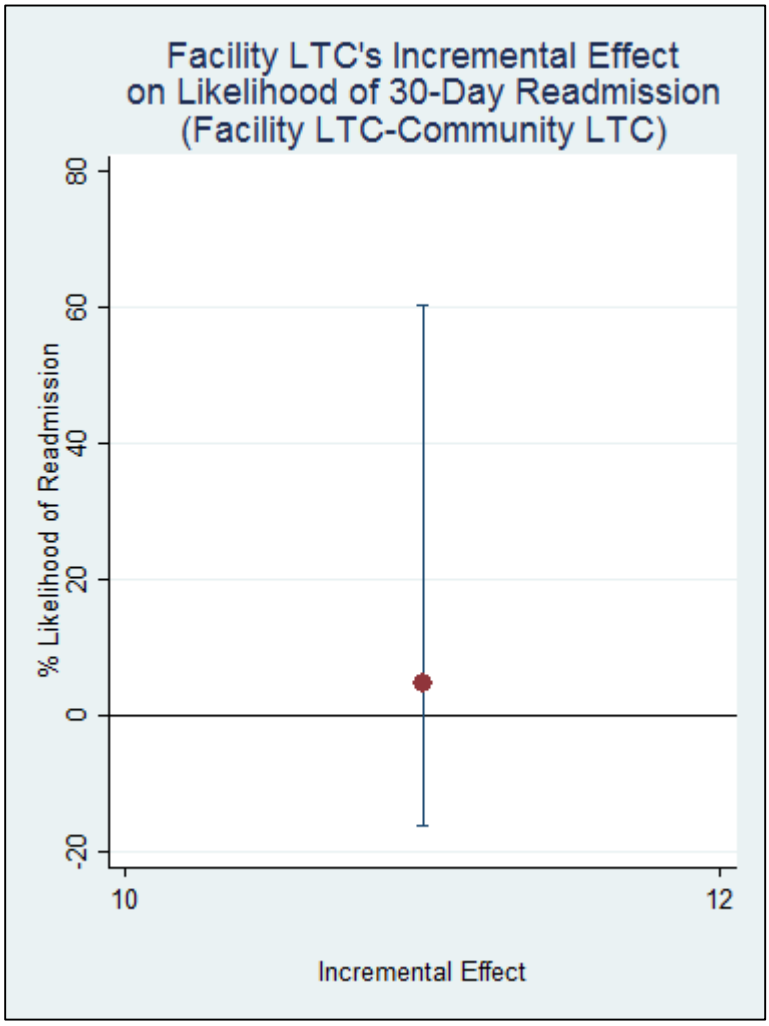


Figure 6.2. Facility LTC's incremental effect on likelihood of 60-day readmission.

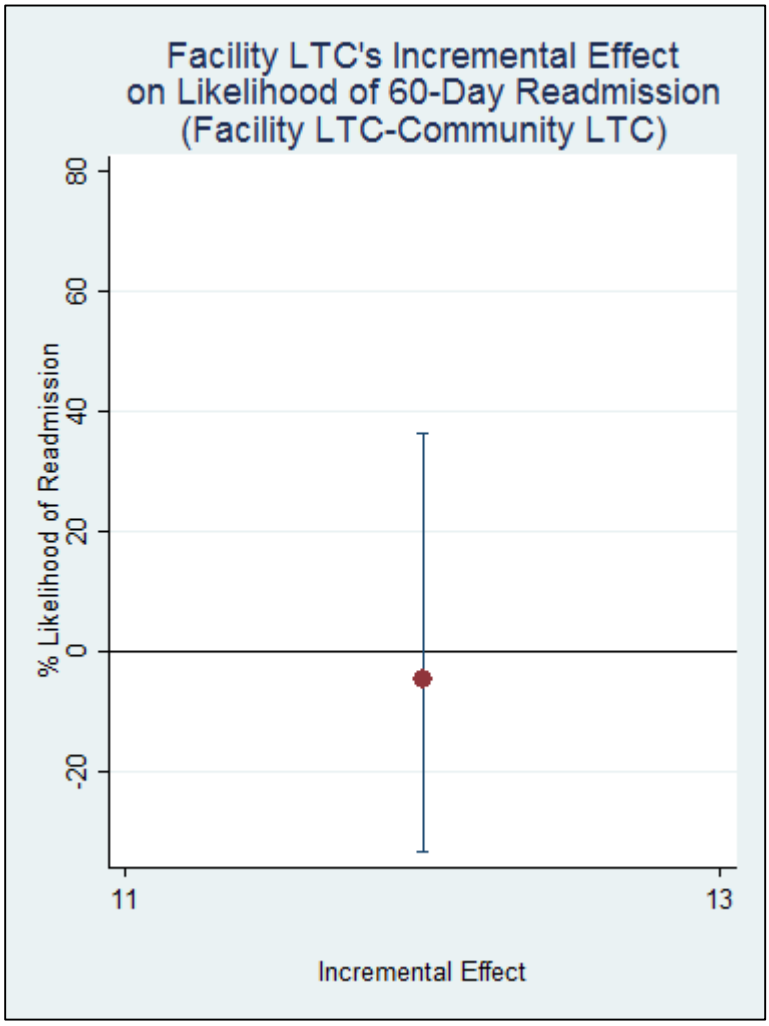
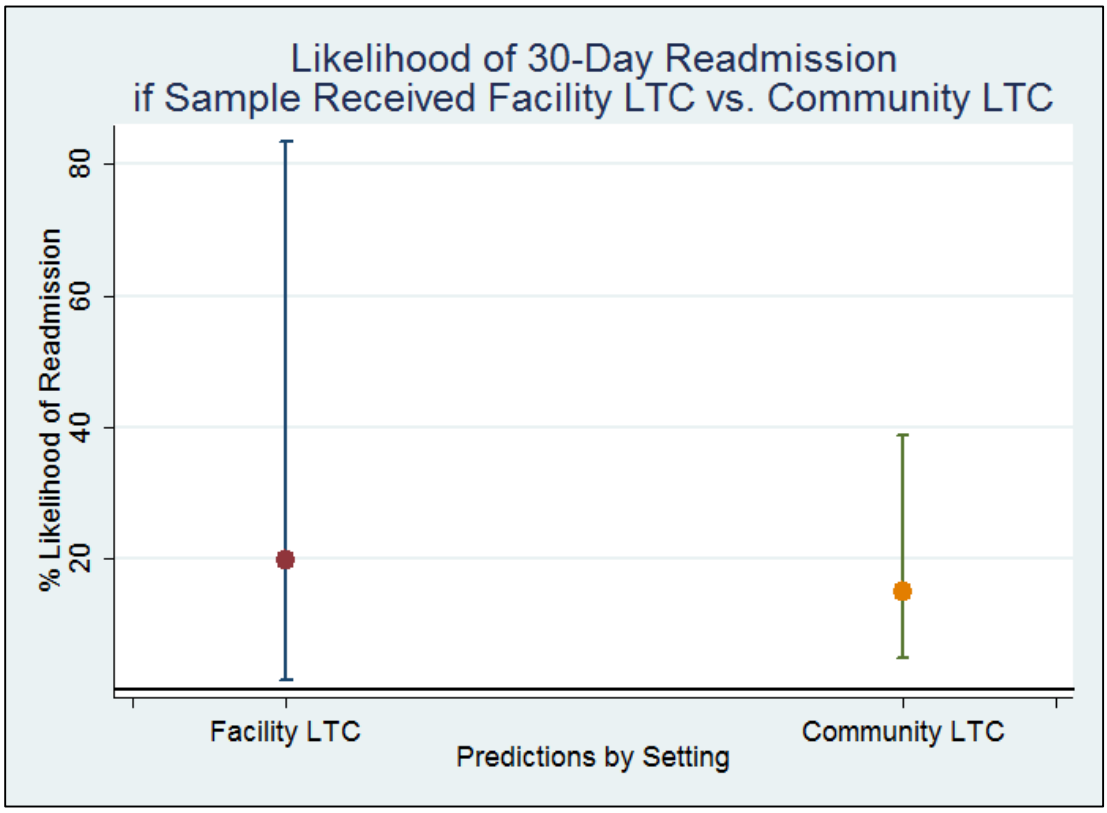


Figure 6.3. Likelihood of 30-day readmission if sample received facility LTC vs. community LTC.



CHAPTER 7. SUMMARY, IMPLICATIONS, AND CONCLUSIONS

This research serves as a starting point to illuminate how LTC services affect healthcare service use. I expected to learn whether and how facility LTC, relative to community LTC, affects Medicare expenditures on specific types of services, as well as healthcare services that are avoidable and potentially wasteful for Medicare. A summary of the findings is presented in Table 7.1. The combined results from all three aims suggest that facility LTC has some effect on certain Medicare expenditures and service use. However, the findings only partially confirmed my hypotheses. My results suggest that incident facility LTC increases Medicare expenditures on sub-acute care as well as ED visits but does not affect expenditures on inpatient or physician services nor likelihood of readmission. This research is policy-actionable in its own right, as well as suggesting a range of follow-up research to better understand the relationships revealed in these studies.

7.1. Summary of Findings

I used an analytic dataset comprised of survey information and Medicare claims from the Medicare Current Beneficiary Survey, zip code–level LTC supply information from the U.S. Census ZIP Code Business Patterns, data derived from the 2000–2009 State Program Reports providing state-level spending on home-delivered meals, and state-level Medicaid payment rates for NFs and percent of Medicaid spending on home and community-based services (HCBS) from the Brown University LTCFocus Web site. Across all three aims, I used number of adult children as an instrumental variable (IV) to predict setting of LTC. The use of the IV addressed the unobservable differences between similarly aged individuals who use facility LTC versus community LTC. Also across all three studies, I used largely the same sample of facility LTC and community LTC users, none of whom used facility LTC during a 3-month wash-out period and then received the respective treatment (facility or community LTC) during a one-year treatment period. I then modeled their Medicare expenditures or service use during a 21-month maximum outcome period.

Study 1 used survival-adjusted models to estimate facility LTC's effect on Medicare expenditures for inpatient and physician services and found no significant total effect of facility LTC on expenditures for either type of service. However, incident facility LTC resulted in significantly lower survival compared to community LTC. Higher mortality significantly lowered expenditures on both types of services across the outcome period (though not enough to affect total expenditures). The IV and non-IV models did not differ for the survival results, suggesting that unobservable characteristics had little effect on mortality rates; however, the point estimates for the IV and non-IV models differed for estimates of the effect on service intensity and the total effect, suggesting that unobservable characteristics may affect how much and what types of services individuals used when alive.

Study 2 also used a survival-adjusted model to estimate facility LTC's effect on Medicare expenditures on sub-acute care (SNF, home health, and hospice). Given the identical sample, the findings on survival were the same as Study 1, with facility LTC having a significant effect on mortality. Again, similar to Study 1, increased mortality decreased expenditures on sub-acute care over the outcome period. However, facility LTC significantly increased sub-acute service intensity over the outcome period (an increase of $2,833 by month 21). These two effects (lower survival rates decreasing the average costs while increased service intensity over survived time increasing average costs) initially increased sub-acute expenditures; however, these countervailing effects resulted in a non-significant total marginal effect in later periods. The IV and non-IV models differed in the estimates of effects due to service intensity and total effects, suggesting again that unobservable characteristics may affect service use when alive.

Study 3 estimated facility LTC's effect on specific types of potentially avoidable healthcare services: ED visits, hospital observation days, and 30-day and 60-day hospital readmissions. First, after estimating facility LTC's effect on ED visits using a survival-adjusted model, I found that facility LTC significantly increased the number of ED visits over the outcome period. Again, lower survival among those who use facility LTC decreased the number of ED visits, but facility LTC increased the intensity of ED service use over time survived. This resulted in a positive and significant total differential effect on the number of ED visits over the outcome period (.1295 increase in the cumulative counts of ED visits by period 16); the effect became non-significant late in the outcome

period. Similar to Study 2, the effects due to service intensity and total effects differed for the IV and non-IV models. I attempted to model observation days using a survival-adjusted model, but after constructing the sample I discovered that I had too few observation days within the sample to model observation days. Finally, I estimated facility LTC's effect on likelihood of 30-day and 60-day readmissions. I constructed a sample of discharges for all eligible treated and control individuals. I modeled likelihood of both readmission and a composite outcome (readmission or death) within 30 or 60 days. I found no significant effect of facility LTC on either likelihood of readmission or likelihood of readmission or death for 30 or 60 days. These non-significant effects were true for both the IV and non-IV models.

7.2. Implications for Policy and Practice

Some of the highest cost and most vulnerable Medicare beneficiaries receive LTC in facilities. LTC facilities face multiple financial incentives to increase residents' healthcare service use. However, because individuals who receive facility LTC are likely more sick, on average, than other beneficiaries, research to date has struggled to identify any independent effect of facility LTC on Medicare expenditures. As a result, policymakers and practitioners have not known whether facility LTC increases Medicare expenditures.

This study provides evidence that LTC setting has an impact on Medicare spending and service use for some beneficiaries, though this impact appears to be concentrated in certain segments of service. Amidst the ongoing conversation about the role of payment and incentives in reducing healthcare costs, this research suggests that policymakers should tailor efforts to target certain types of healthcare, particularly sub-acute care and ED vists, among those who use LTC.

The finding that incident facility LTC decreased survival over the outcome period is concerning and warrants further investigation. First, additional research should work to validate the relationship found here and, with a larger sample size, investigate whether these effects differ by sub-groups. New datasets such as the National Health and Aging Trends Study could be useful for such a validation study. Next, research should illuminate possible causal pathways, including the act of moving residence in a frail, older population; potential increased exposure to potentially life-threatening conditions (falls, infections, etc); facility LTC practice patterns in the treatment of possibly

mortal risks; facility LTC's effect on residents' mental health, which could contribute to decline; and the risks of increased number of transfers to hospitals or other facilities once someone lives in a LTC facility. Additionally, research should examine whether increasing transparency on the quality of LTC facilities alters the mortality rates seen here.

Our non-significant findings on acute and physician expenditures suggest that all LTC providers have an opportunity to decrease healthcare costs. We failed to confirm our hypothesis that facility LTC increased spending on inpatient services. Despite incentives for facility LTC providers to increase utilization of inpatient services, community LTC users did not have relatively lower spending on inpatient care, which may reflect the challenges of providing community LTC. Community LTC providers are often decentralized and face little incentive to integrate with healthcare providers. Although the lack of incentive to increase healthcare use prevents waste, there are also no incentives to decrease healthcare service use for community LTC providers. In these cases, community LTC's decentralized nature may present a challenge to offering such incentives. Future payment mechanisms, such as ACOs, may struggle to integrate the array of formal and informal community LTC providers into their systems. However, because most individuals receive community LTC, new and creative ways to incorporate these providers will be critical to successful cost reduction in the older disabled population.

The findings supported our hypothesis that facility LTC increases spending on certain sub-acute services, including SNF, home health, and hospice. These findings have several implications for ongoing policy efforts. First, facility LTC users may be ideal candidates for cost reduction efforts through the post–acute care bundling demonstrations. However, current segmentation of NFs toward either primarily post-acute rehabilitative care or custodial LTC may be augmented through payment bundling, because hospitals will be incentivized to concentrate their discharges in SNFs that excel at providing post-acute care. At the same time, facility LTC residents may want to receive SNF care in their original facility, regardless of the facilities' expertise in rehabilitation. If so, these high-cost post-acute users may live in and receive post-acute care in LTC facilities that are less influenced by the bundling demonstrations. This may limit the bundling demonstration's effectiveness in cost reduction among the facility LTC population. Second, policymakers should consider Medicare benefit design

that incentivizes facility LTC providers to push for the most appropriate type of sub-acute care at the lowest cost. For example, proposals to redesign hospice for facility LTC recipients such that it includes post-acute rehabilitation, hospice, and facility LTC payment might achieve this end.[202] Finally, efforts to divert limited Medicaid LTC budgets toward community LTC in lieu of NF care should be informed by the potential Medicare cost implications of these efforts. If indeed Medicare could realize positive externalities by advocating for Medicaid LTC re-balancing, these efforts may continue to receive attention from CMS.

Our findings on potentially preventable health services use have several implications. First, the increase in the number of ED visits among facility LTC residents is an important area for future policy development. Creating incentives for NFs to limit ED use and transparent reporting and tracking mechanisms for NF use of EDs would both be useful. Payment policies that incentivize physicians to increase engagement with LTC facilities may help with this issue. However, to the extent that ED use is driven by liability concerns or other systemic issues, ED visits may be difficult to influence through incentives or reporting. Second, our finding that facility LTC did not affect likelihood of later hospital readmission suggests that efforts to reduce readmissions will need to integrate both types of LTC providers into future delivery system reforms. Given the decentralized nature of community LTC providers, hospitals and other coordinators of post-discharge care will need to work creatively to involve these LTC providers.

7.3. Next Steps and Future Research

An immediate follow-up study might revisit the sample and analysis plan used here and estimate total Medicare expenditures over the outcome period. This would help illuminate how the findings on different types of services, which are more policy-actionable, could affect total Medicare spending. Given our survival findings, another immediate follow-up study would be to revisit this research in a different sample of individuals, particularly to investigate the relationship of incident facility LTC on survival. The new National Health and Aging Trends Study is a potential dataset for this analysis. If this relationship is validated, mixed methods investigation into possible reasons for the survival effect (including investigations into care transitions in facility LTC, management or

treatment of risks such as falls or infections, and the mental health of facility versus community LTC recipients) and their associations with mortality risks could help explain our findings.

Future research could include a deeper investigation into the role of LTC providers in end-of-life health care. For example, two possible studies include a study looking at whether LTC setting affects end-of-life expenditures, looking retrospectively from death, and a study identifying how, within facility LTC settings, quality of LTC settings may affect health services use during end-of-life.

A nice complement to these studies would be to investigate the extent to which healthcare service use exhibited here differs from LTC users' patterns of healthcare use in capitated systems. For example, Evercare is a managed care organization that focuses on nursing facility residents. Evidence comparing NF service use in capitated and non-capitated systems could inform the role of LTC in new capitated payments, including Accountable Care Organizations (ACOs). If disabled older adults are the highest cost beneficiaries across payer and payment types, more research into how they use health care within capitated systems will be helpful to ACOs.

Finally, the results presented here could compel qualitative or mixed methods research to determine the role of financial incentives in how LTC facilities and LTC facility residents choose health services, such as choices for sub-acute care. This evidence could help inform the relationship of clinical and financial decision-making in the healthcare use of LTC facility residents.

7.4. Conclusion

Some of the highest cost and most vulnerable Medicare beneficiaries receive LTC in facilities. LTC facilities face multiple financial incentives to increase residents' healthcare service use. This dissertation found that incident use of facility LTC, relative to community LTC, decreased survival over a 21-month outcome period. The studies found that incident facility LTC increased certain types of Medicare expenditures and service use, including sub-acute care and ED visits, but did not increase expenditures on inpatient or physician/practitioner servicers or likelihood of hospital re-admission. This evidence suggests LTC facilities do have influence on residents' healthcare use. Payment and benefit redesign should seek to reward the integration of LTC and healthcare delivery into more appropriate and efficient use of Medicare-covered services for vulnerable older adults.

Table 7.1.

Summary of Findings

Facility LTC's effect on	Due to Survival Differences	Due to Service Intensity	Total Effect
Inpatient Expenditures	significant decrease	non-significant*	non-significant*
Physician/Practitioner Expenditures	significant decrease	non-significant*	non-significant*
SNF, Home Health, & Hospice Expenditures	significant decrease	significant increase*	significant increase*
ED Visits	significant decrease	significant increase*	significant increase*
Readmissions	n/a	n/a	non-significant

*Point estimates substantially different in IV and non-IV models

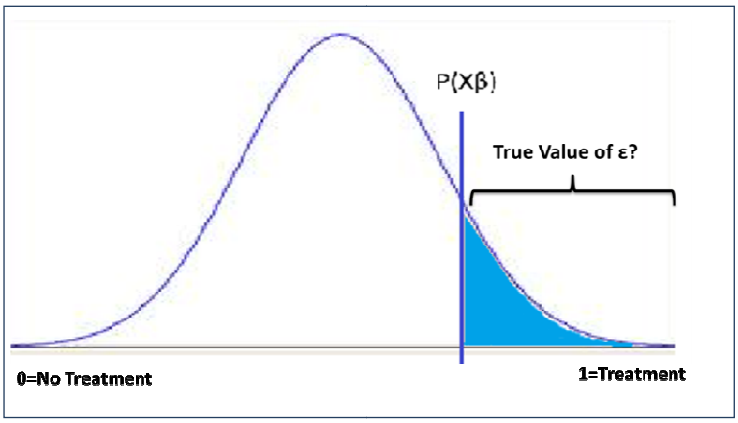
APPENDIX 1

Implementation of 2SRI

In the most common version of the 2SRI, the residual is taken as the difference between predicted likelihood of treatment P(xb) and the true value of treatment (0/1) or =

(See Figure A.1).

Figure A.1. Predicted likelihood of treatment vs. true value of treatment.



However, this approach does not incorporate all the available information we have about these unobservables. Because we know the true treatment, we also know that the true value of the likely treatment (P(xb)) is closer to 1 or 0. That means that the true value of the unobservables affecting treatment are also likely closer to 0 or 1 than this difference represented above.

Thus, the better estimate of is likely one that conditions on the knowledge that the residual is somewhere between the predicted treatment and true treatment. Because we know the lower bounds of the residual (the expected value of treatment), the inverse Mills ratio (in the large fraction term below) helps provide such an estimate, where for a random variable X with mean μ and variance σ^2

The inverse Mills ratio is likely the best representation of the residual.

However, because it is a transformation of the P(xb), we had problems with collinearity in the second stage with the difference in true treatment and the probability of treatment P(t) being collinear with other covariates. Thus, we simulated a value of $\hat{\varepsilon}_1$ given the true value of treatment (similar to but not the same as the inverse Mills ratio). We generated a distribution of possible $\hat{\varepsilon}_1$ values conditional on what is observed in the first stage.

The major advantage of this approach is that it allowed us to include a residual term but eliminated problems with collinearity. The major disadvantage of this approach is that it is really $\hat{\varepsilon}_1 + \omega$ (the simulated piece) and thus is a noisy estimate of $\hat{\varepsilon}_1$. Measurement error tends to bias coefficients on the residual toward zero and create risk of finding no effect or a smaller effect when there is an effect or larger effect. This could cause tests of endogeneity (such as the test of the significant of the residual term in the second stage) to fail to reject exogeneity when, in fact, endogeneity is present.

APPENDIX 2

In the most common version of the 2SRI, the residual is calculated by subtracting the predicted likelihood of treatment P(xb) and the true value of treatment (0/1), or $\hat{\varepsilon}_1 = Treat - \widehat{Treat}_i$. This value is inserted directly into second-stage equations. However, because we know the true treatment, we also know that the true value of the probability of treatment (P(xb)) is closer to 0 or 1. As a result, the true value of the unobservables affecting treatment are also likely closer to 0 or 1. A perhaps better estimate of $\hat{\varepsilon}_1$ is one that conditions on this knowledge that the residual is somewhere between the predicted treatment and true treatment.

Because we know the lower bounds of the residual (the expected value of treatment), the inverse Mills ratio (in the large fraction term below) helps provide such an estimate, where for a random variable X with mean μ and variance σ^2

$$E[X|X > \alpha] = \mu + \sigma \frac{\phi\left(\frac{\alpha - \mu}{\sigma}\right)}{1 - \phi\left(\frac{\alpha - \mu}{\sigma}\right)} \qquad E[X|X < \alpha] = \mu + \sigma \frac{-\phi\left(\frac{\alpha - \mu}{\sigma}\right)}{\phi\left(\frac{\alpha - \mu}{\sigma}\right)}$$

The inverse Mills ratio is likely the best representation of the residual. However, because it is a transformation of the P(xb), we had problems with collinearity in the second stage with the difference in true treatment and the probability of treatment P(t) being collinear with other covariates. Thus, we simulated a value of $\hat{\varepsilon}_1$ given the true value of treatment (similar to but not the same as the inverse Mills ratio). We generated a distribution of possible $\hat{\varepsilon}_1$ values conditional on what is observed in the first stage. The major advantage of this approach is that it allowed us to include a residual term but eliminates problems with collinearity. The major drawback of this approach is that it is really $\hat{\varepsilon}_1 + \omega$ (the simulated piece) and thus is a noisy estimate of $\hat{\varepsilon}_1$. Measurement error tends to bias coefficients on the residual toward 0 and create risk of finding no effect or a smaller effect when there is an effect or larger effect. This could cause tests of endogeneity (such as the test of the significant of the residual term in the second stage) to fail to reject exogeneity when, in fact, endogeneity is present.

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