Potentially Preventable Hospitalizations among Elderly Medicaid Long-term Care Users

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Abstract

Over the last several decades, most states have increasingly shifted their Medicaid long-term care (LTC) expenditures away from primarily institutional services toward more home and community-based services (HCBS). Despite the increase in HCBS, the risk for potentially preventable hospitalizations among elderly Medicaid HCBS users is largely unknown. Given the health implications and the high cost of hospitalizations, it is important to better understand potentially preventable hospitalizations among these LTC users. This dissertation research empirically examined potentially preventable hospitalizations among elderly Medicaid LTC users in community and institutional settings. Specifically this research aimed to (1) identify the factors associated with potentially preventable hospitalizations among elderly Medicaid HCBS users, (2) compare the risk for a potentially preventable hospitalization between elderly Medicaid HCBS users and nursing home residents, and (3) compare the risk for a potentially preventable hospitalization between elderly Medicaid LTC users who transition from a nursing home to a home or community LTC setting and those who remain in a nursing home. Results from these analyses found that potentially preventable hospitalizations were frequent among elderly Medicaid HCBS recipients, and a few conditions accounted for the majority of these hospitalizations. Several characteristics were significantly associated with an increased risk for a potentially preventable hospitalization suggesting that there is variation in preventable hospitalizations among the elderly Medicaid HCBS population and improvements could be made in reducing this variation. After controlling for a number of characteristics and correcting for endogeneity, HCBS users had an increased risk for a preventable hospitalization compared to nursing home residents. More proactive medical care and policies focusing on reducing hospitalizations may be needed for the HCBS population, as well as better aligned incentives for providers to coordinate care. Elderly Medicaid LTC users who transitioned from a nursing home to using HCBS had an increased but non-significant risk for a preventable hospitalization compared with individuals who remained in the nursing home. The medical care and continuity of providers within the nursing home setting are likely important factors in keeping nursing home residents out of the hospital.

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Chapter 1: Introduction

Over the last several decades, most states have increasingly shifted their Medicaid long-term care (LTC) expenditures away from primarily institutional services toward more home and community-based services (HCBS). Despite the increase in HCBS, the outcomes of home and community-based LTC users are largely unknown, including their risk for potentially preventable hospitalizations. Given the health implications and the high cost of hospitalizations, it is important to better understand potentially preventable hospitalizations among these LTC users. This dissertation empirically investigates potentially preventable hospitalizations among elderly Medicaid LTC users in both home and community-based and institutional settings.

Chapter 2: Background

Description of Long-term Care

Long-term care (LTC) consists of a variety of assistive, medical, and social services that help individuals with chronic illnesses, physical disabilities, and/or cognitive disabilities compensate for limitations in their ability to function independently. It includes assistance with activities of daily living (ADLs) such as bathing, assistance with instrumental activities of daily living (IADLs) such as food preparation, supervisory assistance, social and therapeutic support, medical care such as nursing services and rehabilitation, and coordination of other services such as housing. While acute care is generally episodic and short in duration, LTC is generally necessary for a prolonged period of time. However, the frequency and mix of LTC services vary depending on the functional and medical needs, financial situation, and preferences of the individual recipients and their caregivers.

Over 10 million Americans currently need LTC services; about 58 percent of these individuals are age 65 and older, primarily requiring services due to decreased physical and/or cognitive functioning from aging and chronic diseases.[1] While many individuals rely solely on unpaid LTC from family and friends for their needs, a growing number of individuals rely solely or partially on paid (formal) LTC provided through private or public funding streams.[2, 3] Medicaid is the largest payer of formal LTC services, accounting for about 40 percent of total LTC expenditures.[1] In 2009, Medicaid spent $122 billion on LTC services.[1]

Historically, the majority of paid LTC has been provided in institutional settings such as nursing homes, because of the structure of Medicaid financing and limited alternatives. Formal LTC can also be provided in an individual's home or in other community settings such as an assisted living facility, adult foster care home, or adult day care facility. Home and community-based services (HCBS) refer to the range of LTC services that help individuals continue to live at home or in the community, as opposed to an institution.[2, 3] HCBS include such services as home health care, personal care, homemaker services, adult day care, respite care, assisted living, and transportation. There has been a large increase in the supply of HCBS; now most types of LTC needs can be met in a number of alternative settings through a combination of services. The LTC setting does not necessarily reflect the intensity, quantity, or nature of care needs; rather, financing frequently determines the setting.[4]

Medicaid's Role in Long-term Care

All state Medicaid programs are required to cover certain services for Medicaid beneficiaries; most of these required services are primary and acute care services. For dual eligible beneficiaries - individuals who are enrolled in Medicare and also qualify for some level of assistance from their state Medicaid program - Medicare may be the primary payer for the majority of the acute care services that Medicaid covers, but Medicaid pays the Medicare cost-sharing requirements and fills in the gaps.[5] Medicaid also covers certain LTC services for beneficiaries that meet the financial and functional need criteria that are set for each specific LTC service. Because Medicare covers acute and post-acute services but does not cover LTC services, Medicaid is the primary payer

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for LTC services for dual eligible beneficiaries. Each program has an incentive to limit spending, so neither program takes full responsibility for dual eligibles. This system not only creates a tension between Medicare and Medicaid for the management and quality of care of dual eligibles, but it may also lead to cost-shifting between the programs.[5]

Nursing home services are federally mandated services under Medicaid for categorically eligible individuals age 21 and older (i.e., individuals who meet the income and asset requirements for the state Medicaid program). Categorically eligible individuals must also meet nursing home service eligibility criteria, or level-of-care criteria. The criteria are based on the medical and functional need of the individual.[6]

States may also offer Medicaid home and community-based LTC through three programs: (1) optional 1915(c) waivers, (2) optional personal care state plan benefits, and (3) mandatory home health state plan benefits. The 1915(c) waivers, or HCBS waivers, permit the Center for Medicare and Medicaid Services (CMS) to "waive" certain statutory requirements of the Medicaid program for states to provide services that are not normally available to beneficiaries in order to prevent institutionalization. States apply to CMS to offer specific HCBS waivers through their Medicaid program. With these waivers, states can target services to specific populations (e.g. aged/disabled, intellectually disabled/developmentally disabled), limit the number of "slots" (the number of beneficiaries that can receive services through the waiver), and choose what services to offer. Once individuals have met the targeting criteria (e.g., age) for the waiver, they must also meet the service criteria, which is equivalent to the level-of-care criteria that states use to determine nursing home eligibility. The level-of-care criteria clearly lay out

the type and level/severity of functional limitations and/or medical and nursing needs that an individual must have to receive institutional services. Services that may be provided through HCBS waivers include homemaker services, home health aide services, personal care services, adult day services, and case management. Over the last several decades, there has been large growth in the number of different HCBS waivers offered and in the number of waiver recipients.[6,7]

States can also offer personal care services as a Medicaid state plan benefit. Unlike waivers, state plan benefits require that services are available to all Medicaid categorically eligible groups, so states cannot limit the number of "slots" if they choose to offer the optional personal care state plan benefit. However, states do have discretion in defining the service criteria (functional and medical needs) to receive state plan personal care services, and they can set coverage limits on benefits. Services under the personal care state plan include services that provide assistance with ADLs and IADLs.[6,7]

The Medicaid program requires that states offer home health services as a mandatory state plan benefit to individuals that are categorically eligible for nursing home care, but home health services are optional for other individuals. In order to receive home health state plan benefits, categorically eligible individuals must have a physician order the services as part of a plan of care and the services must be medically necessary. States can place some coverage limits on home health services based on a determination of medical necessity. Services include part-time nursing services, home health aide

services, medical supplies and other equipment for the home, and an additional list of services at the state's discretion.[6, 7]

The proportion of Medicaid LTC spending on HCBS has increased considerably over the last several decades, growing from 19 percent in 1995 to 43 percent in 2009.[1] Of the $122 billion that Medicaid spent on LTC services in 2009, $52.8 billion was spent on HCBS and about $69.2 billion on institutional care.[1] There is variation across states in the proportion of expenditures for HCBS versus nursing home care, as well as variation within states across recipient groups. While a higher proportion of young beneficiaries who require LTC are served in home and community-based settings, a substantial portion of elderly are also served in home and community-based settings. The trend has been increasing over time and is expected to continue.[8] The enduring pressure to provide more HCBS to individuals who require LTC has stemmed from consumers' preferences to remain at home or in the community, family members' preferences to keep loved one's in their homes or in community settings, concerns about the quality and high cost of institutional care, and federal and state rulings, such as the 1990 Americans with Disability Act and the 1999 Olmstead Supreme Court decision, which require alternatives to institutional care for disabled individuals.[3, 9]

Hospitalizations among Long-term Care Users

Because elderly individuals with LTC needs are generally quite frail, they may be at high risk for hospitalization.[4] For instance, between 15 and 25 percent of long-stay nursing home residents are hospitalized within any given six-month period.[10-13]

While hospitalizations may help alleviate symptoms, treat acute or chronic illness, and maintain or restore function in the frail elderly, they can often be traumatic for this population. Frail older patients are more vulnerable to iatrogenic events in the acute hospital setting, including delirium, falls, incontinence, dehydration, adverse drug effects, and nosocomial infections. Hospital transfers can be physically uncomfortable and disorienting and can lead to confusion and further decline.[14, 15] After a hospitalization, individuals must endure another transfer to their permanent home or to a post-acute setting. They may require further skilled care or rehabilitation services, and they may have extra medications to manage which can complicate their care. In addition to these numerous health and quality of care concerns, hospitalizations are also very costly.[16, 17]

An individual's health status, including his or her current condition or health state, other conditions and comorbidities, and overall frailty, is a primary consideration for hospitalization, but there are a number of other factors that go into the decision to hospitalize a LTC recipient. The individual's preferences play a role in whether or not he or she is hospitalized. This includes the LTC recipient's beliefs about the aggressiveness of treatment that he or she wants to pursue, his or her quality-of-life in their current state, and the disruption that may occur if he or she is transferred to the hospital. Family or caregivers' preferences may also factor into the decision, including their ability to provide care and offer assistance for various tasks and medical visits. Medical providers in outpatient settings and within the nursing home see patients on an ongoing basis for chronic conditions and are frequently seen for acute conditions prior to a hospitalization. The providers' training and beliefs about the best setting for the individual and their

overall uncertainty of the severity of the health issue play a role in hospitalizations. An

important factor is the ability to manage the individual in their current setting, given the

availability of resources and equipment and access to the necessary medical visits to treat

the condition, and the safety of the individual given other constraints on LTC staff time.

A factor related to this may be a fear of litigation, particularly for nursing homes.

Physicians and administrators may be concerned that family members could pursue legal

action if an individual deteriorates and they chose to treat him or her within the facility

rather than hospitalize him or her. A number of policy and financial incentives may factor

into hospitalizations as well. For instance, nursing homes may need to devote substantial

resources toward caring for certain residents within the facility, but there is no penalty

against them for hospitalizing the resident, leading to a financial incentive to hospitalize

residents instead of treating them within the facility. Overall the decision to hospitalize an

individual weighs these factors, taking into consideration the potential benefits and harms

of the hospitalization.[18, 19]

Because of the quality of care concerns and the high cost of hospitalizations

among the frail elderly, previous research has explored clinical and nonclinical factors

that influence hospitalizations of nursing home residents. The nonclinical factors include

resident-specific characteristics, nursing home-specific characteristics, market, and policy

factors.[4, 18] While most of this research has examined all hospitalizations of nursing home

residents, a few studies have specifically examined hospitalizations that may be

considered potentially preventable. "Potentially preventable," "potentially avoidable," or

"ambulatory care sensitive" hospitalizations refer to hospitalizations that stem from

medical conditions thought to be largely avoidable and/or manageable through timely access to outpatient physician and other medical support services. Conditions that may lead to potentially preventable hospitalizations include asthma, diabetes, hypertension, congestive heart failure, chronic obstructive pulmonary disease, and pneumonia.[20] There has been a recent focus on these hospitalizations, particularly among nursing home residents, because it is believed that they have the greatest potential for reductions and could be reduced without compromising the care of residents. Many of these conditions could be treated in an individual's current setting without hospitalization, and some of them may be able to be prevented altogether.

Reducing hospitalizations among the nursing home population has become an important policy goal due to the quality and cost concerns among this population, as well as the potential for cost-shifting between Medicaid and Medicare, and initiatives aimed at reducing these hospitalizations have been implemented. For instance, the Medicare-Medicaid Coordination Office in collaboration with the Center for Medicare and Medicaid Innovation is soliciting proposals due in June 2012 for organizations and partnering nursing facilities to participate in a demonstration project with the goal of reducing preventable hospitalizations among nursing facility residents (see https://www.cms.gov/Medicare-Medicaid-Coordination/Medicare-and-Medicaid-Coordination/Medicare-Medicaid-Coordination-Office/ReducingPreventableHospitalizationsAmongNursingFacilityResidents.html). Additionally, the Medicare Nursing Home Value-Based Purchasing Demonstration, which is currently being implemented, rewards nursing homes based on their quality

performance in four domains, including the rate of potentially avoidable hospitalizations (see https://www.cms.gov/Medicare/Demonstration-Projects/DemoProjectsEvalRpts/downloads/NHP4P_FactSheet.pdf). Research and policy initiatives have primarily focused on hospitalizations among nursing home residents but less is known about hospitalizations among other LTC users.

Like residents in nursing homes, individuals receiving HCBS need primary and acute care in addition to support for functional limitations, and there is overlap in their acute and LTC needs. How LTC needs are fulfilled or not fulfilled in a particular setting also affects how primary and acute care needs are dealt with. Hospitalizations, particularly potentially preventable hospitalizations, may be considered failures to meet LTC users' basic care needs, regardless of the LTC setting.[4] It is not clear whether the needs of individuals using HCBS are met to avoid unnecessary hospitalizations and whether they have particular risks for potentially preventable hospitalizations.

Residents in nursing facilities receive a certain level of professional medical care from nursing staff as well as physicians, which is included in the daily nursing home room rate, while individuals who reside at home or in the community may not receive the same level of medical care and clinical monitoring in their setting. Therefore, HCBS users may utilize more outpatient or acute services (e.g., physician visits, hospital visits) to compensate for the lack of medical attention in their living setting.[21] However, it is not known if their medical needs are met within home and community settings where there is less of a professional medical model and whether the setting impacts the risk of a potentially preventable hospitalization.

Because of the growing significance of home and community-based alternatives for LTC users, it is important to understand potentially preventable hospitalizations among the home and community-based LTC population. Since states have considerable discretion in determining the structure of their LTC programs and services, it is also important to understand how potentially preventable hospitalizations among LTC users in different settings compare. Just as nursing home residents, elderly home and community-based LTC users often have complex needs, and they are at risk for the same quality of care and health concerns as nursing home residents; reducing potentially preventable hospitalizations is likely an important policy goal for this population of LTC users as it is for the nursing home population.

Literature on Potentially Preventable Hospitalizations

There has long been concern that many individuals do not have adequate access to health care services due to barriers such as costs, lack of health insurance, and the shortage of appropriate providers or services. Many people argued that expanding access to primary care providers could lead to more timely and effective ambulatory care and reduce the risk of hospitalization for certain medical conditions by preventing the onset of the disease, by controlling an acute episodic illness or condition, or by managing a chronic disease or condition in such a way as to prevent progression of the disease to a point requiring hospitalization. With this in mind, Billings and colleagues developed a list of primary diagnoses for which hospitalizations could have been prevented with timely and effective ambulatory care, and these diagnoses are referred to as ambulatory care sensitive (ACS) conditions.[20] The Agency for Healthcare Research and Quality (AHRQ)

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used the ACS conditions to create a set of measures at the population level called the Prevention Quality Indicators (PQIs), which are intended to provide insight into the health care system within a community (see http://www.qualityindicators.ahrq.gov/modules/pqi_overview.aspx). While varying rates of hospitalization for ACS conditions among different subgroups may be indicative of problems, it is worth noting that the hospitalizations are not necessarily unneeded or inappropriate at the time they occur; these are simply conditions where effective ambulatory care exists that may have prevented the condition from getting to the point that a hospital admission is perceived to be necessary. It is important to recognize that this list identifies diagnoses for which better care might reduce the likelihood of hospitalization; not all ACS hospitalizations are preventable because there may be specific cases where even the best care cannot prevent the progression to a point that requires hospitalization. Despite the potential for some misclassification, a body of research has used these conditions and provided insights into areas for improvement.[20]

The ambulatory care sensitive conditions were originally developed for the community-dwelling population under age 65, and the initial research on factors related to ACS hospitalizations focused on this population. This research found that after adjusting for disease severity, variations in ACS hospitalizations existed, and they were influenced by such factors as socioeconomic status, insurance status, race, and age.[22-24] Subsequent research used the ACS conditions to explore hospitalizations among elderly community-dwelling individuals age 65 and older.[25, 26] These studies found variations in

ACS hospitalizations influenced by similar factors as those found among younger

populations, including age, race, socioeconomic status, and geographic location.

Literature on Hospitalizations among Elderly Nursing Home Residents

Numerous studies have examined hospitalizations among nursing home residents,

and several reviews of this literature have been completed.[18, 27] The evidence suggests

that the hospitalization of nursing home residents is relatively common; a range of studies

that used different geographic areas, types of nursing homes, patient populations, and

follow-up times have estimated the rate of hospitalization from 9 percent to 59 percent.[18]

A number of patient, facility, and policy factors have emerged as being associated with

hospitalizations from the nursing home. Patient characteristics that have been found to be

related to hospitalizations include gender, age, payer source, length of stay, physical and

cognitive disability, specific health conditions (e.g., congestive heart failure, circulatory

problems), and preferences, as represented by the presence of advance directives. Facility

characteristics associated with hospitalizations include resident care practices, staffing,

provision of ancillary services, hospice use, and profit status. Policy factors that have

been found to be associated with hospitalizations include Medicaid payment rates and

bed-hold policies. Although these factors have generally been consistent with theory, the

evidence is limited by the samples used in the analyses, the variety of measures used

across studies, and the potential for selection bias in certain studies.[18]

While most studies have examined all hospitalizations among nursing home

residents, a subset of these[13, 16, 28-30] have used the ACS conditions to explore potentially

preventable nursing home hospitalizations; these studies are reviewed below. The ACS

conditions are useful for this population because variations in the rates of ACS

hospitalizations across nursing home that are related to factors other than case-mix

differences may indicate whether some residents are hospitalized unnecessarily and/or

not receiving medical services that could prevent these hospitalizations.

Carter[29] used Medicaid data for nursing home residents in Massachusetts from

1991 to 1993 to estimate the relationship between patient risk factors, facility factors, and

market area factors and variations in ACS hospitalization rates among nursing home

residents. Data from Medicare hospital claims, Medicare Provider of Service files, the

Massachusetts Rate Setting Commission, and the Massachusetts death registry file were

also used. A two-step logistic regression approach was used, in which any hospitalization

was modeled in the first step and, conditional on a hospitalization occurring, an ACS

hospitalization was modeled in the second step. A number of resident characteristics,

such as gender, certain diagnoses, and physical restraint use, and some facility

characteristics, such as a greater proportion of patient days reimbursed by Medicare and

the amount of spending on different types of staff, were associated with ACS

hospitalizations. No market-level factors were significant. Even though this study

provided useful insights, there were a number of limitations to the study. The sample

included residents in only one state, which may reduce the generalizability of the results.

The two parts of the logistic regression model were not combined, as is typically done in

economics and health services research literature, to get the overall estimate of the

contribution of different characteristics on ACS hospitalizations.[18] Although the

Massachusetts death registry was used, there was also no explanation about how this study dealt with residents who died during the analysis period.

Intrator, Zinn, and Mor[13] examined the relationship between nursing home characteristics and potentially preventable (ACS) hospitalizations among long-stay residents aged 65 and older in four states in 1997. The authors defined a four-category hierarchical outcome variable based on 6-month utilization: (1) any hospitalization(s) with an ACS diagnosis as the primary discharge diagnosis; (2) any other hospitalization(s); (3) died; (4) reference group, assumed to have remained alive in the facility. The independent variables of interest included staff availability variables, such as having a nurse practitioner/physician assistant (NP/PA) available on staff or by contract, and facility service indicators, such as the availability of on-site intravenous (IV) therapy. Other independent variables included resident-level variables to control for resident risk and acuity, facility-level variables to control for characteristics like profit-status, and market-level variables to control for demand and location. Separate multilevel logistic regression models were estimated for each outcome compared to the reference group. The authors used a propensity score analysis to get unbiased estimates of the effect of having NP/PAs available since NP/PAs are not randomly assigned to facilities. The effects were generally small but indicated that the employment of NP/PAs, the availability of IV therapy, the existence of an aide training program, and a higher prevalence of do-not-resuscitate orders in facilities were all associated with a lower likelihood of hospitalization for an ACS condition. The results suggest that residents' diagnoses, conditions, and functional status largely determine hospitalizations of long-

stay nursing home residents. Despite the improvement of this study in defining an outcome for mortality and attempting to control for selection issues, there are some issues to note. First, many residents were excluded from the analysis, including residents in rural nursing facilities and urban hospital-based facilities, so the results can only be generalized to a particular group of nursing home residents. As reported by the authors, facility staffing and case mix taken from the On-line Survey of Certification Automated Records (OSCAR) are often inaccurate, so the measures used in the analysis may be imprecise. While the analysis used data from four states (Kansas, Maine, New York, and South Dakota), the majority of nursing facilities in the final sample were located in New York, which has different regulation and reimbursement levels than other states. Additionally, there is the potential for selection bias and endogeneity; since nursing facilities control the type and size of their staff and the availability of on-site services and they have some discretion over the resident case mix and payer, the selection of nursing facility characteristics on hospitalizations confounds the estimates.

To examine whether nursing facility residents are affected differently by facility-level risk factors, Carter and Porell[30] focused on ACS hospitalizations among nursing facility residents with Alzheimer's disease and related dementias (ADRD). As in the previous study by Carter,[29] the authors used Medicaid reimbursement data from Massachusetts from 1991 to 1993, along with Medicare hospital claims, Medicare Provider of Service files, cost reports from the Massachusetts Rate Setting Commission, and data from the Massachusetts death registry file. The study population included dually eligible nursing home residents aged 65 years and older who were not enrolled in an

HMO; one sample included residents who had a diagnosis of ADRD during the study time frame and the other sample included residents without any recorded diagnosis of ADRD. The outcome variables of interest included: (1) hospitalization for any ACS condition, (2) hospitalization for an infectious ACS, (3) hospitalization for bacterial pneumonia, (4) hospitalization for gastroenteritis, and (5) hospitalization for kidney and/or urinary tract infection. Resident-level control variables included a set of resident attributes, a set of clinical diagnostic dummy variables, and a set of prior hospital use variables. Facility-level quality-of-care measures were included, such as the use of physical restraints and a reported accident in the past 90 days, as well as facility-level characteristics, such as nonprofit status, staffing levels, and reimbursement mix. A control for market concentration was also included. Separate logistic regression models for the five outcomes and ADRD status were estimated using general estimating equations. The findings suggest that nursing home residents with ADRD are more likely to be hospitalized for certain ACS conditions, including gastroenteritis and kidney/urinary tract infections. Greater use of nurse practitioners and registered nurses and overall quality-of-care practices were associated with a lower risk of ACS hospitalizations among residents with ADRD. Because this study utilized the same data as the previous study by Carter,[29] several of the same issues apply to this study, including a limited population and no explanation about how mortality was dealt with in the analysis.

Grabowski, O'Malley and Barhydt[16] estimated expenditures for ACS hospitalizations for long-stay nursing home residents in New York. The authors used

individual nursing home data from the Minimum Data Set (MDS) for the period 1998 to 2004. The MDS assessments for long-stay residents (in the nursing home for at least 120 days) were linked to the New York Statewide Planning and Research Cooperative System (SPARCS) hospital inpatient data set. This data set includes demographic, diagnostic, procedural, payer, and other financial information for each admission to an acute care hospital in New York. The authors focused only on inpatient hospitalizations since SPARCS did not contain consistent data for outpatient and emergency department hospital visits for the study time period. For the expenditure analysis, the authors adjusted the charge data to reflect costs, used the medical Consumer Price Index to adjust the dollar values for inflation, and identified hospitalizations with an ACS primary diagnosis. Inflation-adjusted spending on nursing home hospitalizations increased between 1999 and 2004. Aggregate spending on nursing home hospitalizations totaled about $972 million in 2004, and about $223.8 million, or 23 percent, was for ACS hospitalizations. Medicare was the primary payer for about 84 percent of these ACS hospitalizations, while Medicaid was the primary payer for about 12 percent. There was a high concentration of spending on relatively few of the ACS conditions, indicating that targeted prevention and treatment interventions in nursing homes may be useful. Even though this study provides insight into the magnitude of spending on nursing hospitalizations and the potential for cost savings to public programs, the authors point out a number of limitations to this analysis. First, the data came from only one state, so the results may not apply to other states. Second, the authors' estimates did not include other spending associated with the hospitalizations, such as physician or medical

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transportation costs, and they did not include costs for outpatient hospital costs or emergency department costs, so the results likely underestimate expenditures. Third, the data only contained hospital spending, not the payment received by payers. Fourth, the authors may have excluded any long-stay residents who were discharged before 120 days.

Becker et al.[28] examined risk factors for ACS hospitalizations among Medicaid-enrolled nursing home residents in Florida, with a specific focus on mental disorders and dementia. The study population included all Medicaid nursing home residents in Florida from 2003-2006. The authors used Medicaid claims and enrollment data from 2003-2006 for resident characteristics and expenditures and data from the Online Survey Certification and Reporting (OSCAR) system for nursing facility characteristics. Resident characteristics included age, gender, race, Charlson score (as an indicator of physical health), and specific diagnoses for severe mental disorders (such as bipolar and major depression) and dementia. Facility characteristics included such variables as ownership type, size, citations, and staffing ratios. The authors estimated the relative risk of ACS hospitalization using Cox proportional hazards regression. They found that younger age, a diagnosis of a severe mental disorder, and a diagnosis of dementia all independently increased the risk of an ACS hospitalization. This study was limited by the reliance on data from only one state. Also, the authors did not discuss how they dealt with residents that died during the study period, and they did not model the risk for mortality.

Other studies have utilized alternative definitions to explore the potential for avoidable hospitalizations among nursing home residents, including classifications of

discretionary hospitalizations[31] and ratings of appropriate/inappropriate[32] and unavoidable/potentially avoidable[33] from expert reviews of medical records. These studies also indicate that a large proportion of hospitalizations may be avoidable and that the rates vary across different facilities.

Literature on Hospitalizations among Home and Community-based Long-term Care Users

Few studies have examined potentially preventable hospitalizations among home and community-based LTC users. One study examined potentially preventable hospitalizations among community elderly LTC users in the Minnesota Senior Health Options (MSHO) program.[34] This is a voluntary program for dually eligible individuals where participants receive all acute and long-term care through a health maintenance organization (HMO) that integrates Medicaid and Medicare funding. The evaluation of this program analyzed all hospitalizations and ACS hospitalizations. Analyses were completed for the first three years of the program (1997 to 2000) by comparing MSHO enrollees from the seven demonstration counties to (1) dually eligible individuals who lived in MSHO counties but did not enroll (control-in group) and to (2) dually eligible individuals who lived in counties where MSHO was not offered (control-out group). This evaluation found that after adjusting for demographic characteristics and prior utilization, community MSHO enrollees had significantly fewer preventable hospital admissions than the community control-in group. While this study used the ACS conditions for community-dwelling LTC users, the results are only generalizable to beneficiaries in this targeted managed care program that includes capitation and integrated care.

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An evaluation of the Wisconsin Partnership Program (WPP) also analyzed potentially preventable hospitalizations.[35, 36] This program combines Medicaid and Medicare funding to provide acute and long-term care dual eligibles with the support of an interdisciplinary team, allowing enrollees to live in the community. In one study, outcomes of WPP enrollees were compared to enrollees in another managed care program (the Program of All-Inclusive Care for the Elderly or PACE), which is similar to WPP in all respects except the structure and role of the interdisciplinary team.[35] This study found that PACE enrollees had a lower risk of potentially preventable hospitalizations. In the second study, WPP enrollees were compared to (1) fee-for-service dual eligibles receiving HCBS waiver services in the same geographic area and (2) fee-for-service dual eligibles receiving HCBS waiver services in a location in the state where WPP was not offered.[36] The control group in the same geographic area had a significantly higher risk of potentially preventable hospitalizations than WPP enrollees, but there were no other significant differences. These results provide insight into how managed care HCBS users compare to fee-for-service HCBS users, but they do not provide insight into characteristics that are important factors for each of these groups or how these groups might compare to institutional LTC users in their risk for a potentially preventable hospitalization.

One report analyzed potentially avoidable hospitalizations among dual eligible beneficiaries of all ages in Medicaid-covered nursing facility stays, Medicare-covered skilled nursing facility stays, and aged or disabled Medicaid HCBS waiver programs in all states in 2005.[17] In order to analyze avoidable hospitalizations for each of these groups

of beneficiaries, the authors identified a comprehensive list of conditions, largely similar to ACS list of conditions, where hospitalizations could likely be avoided. The authors divided this list into a set for nursing facility residents and a set for HCBS enrollees, and these groups were then analyzed separately to understand the pattern of avoidable hospitalizations among dual eligibles receiving care through different programs. Potentially avoidable hospitalizations were found to be frequent among all groups, and Medicare assumed the majority of the expenses for the hospitalizations. These hospitalizations varied greatly by state, and a few factors were found to be significantly associated with risk for a potentially avoidable hospitalization, such as race/ethnicity. This report is the first to analyze potentially avoidable hospitalizations among beneficiaries in different Medicaid and Medicare programs who reside in different settings, but the insights from this report are limited. The HCBS population included individuals who had any period of enrollment in an aged and disabled HCBS waiver, but there was no distinction made about the length of time individuals were enrolled in these waivers, and individuals receiving Medicaid HCBS through state plans were not included in the analyses. Only one year of data was used for these analyses, and only a limited number of individual characteristics were analyzed in the models. A different definition of the outcome and different empirical models were used for the nursing home and the HCBS populations, so it is not possible to compare the results between these populations or to understand whether the risk for potentially avoidable hospitalizations differ significantly between these populations.

One recent study examined potentially avoidable hospitalizations among all Medicaid recipients, including HCBS users.[37] The authors presented unadjusted rates of potentially avoidable hospitalizations, defined by ACS conditions, in 2005 among all Medicaid recipients and different groups of HCBS users (e.g., aged/physically disabled, under age 65/over age 65, intellectually and developmentally disabled). They found that rates of potentially avoidable hospitalizations were much higher for HCBS users compared with the general Medicaid population, and they conclude that HCBS users are a particularly vulnerable population, and more research is needed to understand the outcomes of these vulnerable individuals. While this study provides more information on the rates of potentially avoidable hospitalizations among different groups within Medicaid, the authors did not do any adjusted models to further explore how the rates of these hospitalizations differ among the groups.

Summary of Literature

Studies among nursing home residents have found several resident characteristics to be significantly associated with potentially preventable hospitalizations, including age, gender, and specific diagnoses such as dementia and severe mental disorders.[13, 28-30] Facility characteristics, including the proportion of patient days reimbursed by Medicare, the employment of NP/PAs, the availability of IV therapy, the existence of an aide training program, and a higher prevalence of DNR orders, have also been found to be significantly associated with potentially preventable hospitalizations.[13, 29] However, there were a number of limitations to these studies, including limited samples and time frames, not accounting for mortality, and potential selection issues. A few studies that explored

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potentially preventable hospitalizations among home and community-based LTC users examined enrollees in specific managed care programs, so they do not provide much insight into home and community-based LTC users in general.[34-36] Two studies have explored potentially preventable hospitalizations among Medicaid HCBS users, providing some evidence about the frequency of potentially preventable hospitalizations among Medicaid HCBS users and characteristics that may impact these hospitalizations.[17, 37] Despite the contribution of these studies, there is still little evidence about individual characteristics that influence potentially preventable hospitalizations of Medicaid HCBS users and about how these LTC users compare to nursing home residents.

Contribution of Dissertation to Previous Work

This dissertation research empirically examines potentially preventable hospitalizations among elderly Medicaid LTC users in community and institutional settings to better understand health outcomes for these individuals. Specifically this research aimed to (1) identify the factors associated with potentially preventable hospitalizations among elderly Medicaid HCBS users, (2) compare the risk for a potentially preventable hospitalization between elderly Medicaid HCBS users and nursing home residents, and (3) compare the risk for a potentially preventable hospitalization between elderly Medicaid LTC users who transition from a nursing home to a home or community LTC setting and those who remain in a nursing home.[a]

This dissertation furthers the knowledge about potentially preventable hospitalizations among elderly Medicaid HCBS users. Results provide insight into the

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[a] This dissertation was approved by the University of Minnesota Institutional Review Board.

relationship between LTC and acute care for individuals receiving HCBS. This dissertation also compares the risk for a potentially preventable hospitalization between individuals in community and institutional settings, which has not been done in previous work. The findings provide a better understanding of how LTC setting impacts acute care. Additionally, this dissertation examined how LTC and acute care needs are met when an individual transitions from a nursing home to a home or community-based LTC setting. Little work has been done to explore outcomes of LTC users after a change in the LTC setting and main source of care has occurred, so this work will contribute to the literature on individuals making transitions between LTC settings.

In addition to filling gaps in the literature, this dissertation improved on previous studies examining potentially preventable hospitalizations among nursing home residents and HCBS users. It utilizes data from multiple states and years so the results are more generalizable. The study populations include elderly individuals in HCBS waiver programs, community state plan programs, and nursing homes, so LTC users served through the range of LTC programs within Medicaid are analyzed. Mortality was modeled explicitly, so the analyses accounted for individuals that died. Additionally, because there was the possibility of selection bias when estimating the effects for individuals in different LTC groups, methods that correct for selection bias were used to obtain unbiased estimates. For research aim two, this included an instrumental variable analysis, which corrects for selection on unobservables, and for research aim three, this included a propensity score analysis, which corrects for selection on observables.

Chapter 3: Patient Factors Associated with Potentially Preventable Hospitalizations among Elderly Medicaid Home and Community-based Long-term Care Users

Background

Elderly nursing home residents have a high risk for hospitalization.[18] Though hospitalizations can improve a patient's health status and function, they can be particularly distressing for elderly nursing home residents. These individuals are vulnerable to adverse events and transfers between multiple settings can be physically uncomfortable and disorienting, sometimes leading to further decline.[14, 15] Hospitalizations for these individuals are also very costly.

Because of the potential health and financial implications of hospitalizations, many studies have focused on understanding the factors related to hospitalizations of nursing home residents. A number of patient, facility, and policy factors have been found to be associated with hospitalizations among nursing home residents.[18, 27]

While most studies have examined all hospitalizations among nursing home residents, a subset of studies have examined potentially preventable or potentially avoidable hospitalizations.[13, 16, 28-30] Potentially preventable hospitalizations refer to hospitalizations that result from conditions or events that are thought to be avoidable altogether or manageable in an individual's current setting with access to medical and outpatient services.[20] It is believed that if these conditions could be treated at a lower level of care or prevented altogether that hospitalizations could be reduced without compromising the care of individuals. The studies focusing on nursing home residents have found several resident characteristics to be significantly associated with potentially

preventable hospitalizations, including age, gender, and specific diagnoses such as dementia and severe mental disorders.[13, 28-30] Facility characteristics, including the proportion of patient days reimbursed by Medicare, the employment of nurse practitioners or physician assistants, the availability of on-site intravenous therapy, the existence of an aide training program, and a higher prevalence of do-not-resuscitate orders, have also been found to be significantly associated with potentially preventable hospitalizations.[13, 29]

Although nursing home care remains an important component of LTC for elderly individuals, preferences have been changing, and there has been substantial investment in home and community-based services (HCBS) by state Medicaid programs.[1, 3] HCBS refer to the range of LTC services that help individuals continue to live at home or in the community, as opposed to a nursing home.[2, 3] The proportion of elderly HCBS users has been growing over the last several decades, and it is expected that the use of HCBS among the elderly will continue to grow.[8] Despite the investment and growth in HCBS, little is known about hospitalizations, and particularly potentially preventable hospitalizations, among these LTC users. Like residents in nursing homes, individuals receiving HCBS need medical care in addition to support for functional limitations, and there is overlap in their LTC and medical needs. How an individual's LTC needs are fulfilled or not fulfilled within their setting also affects how their medical needs are dealt with. Potentially preventable hospitalizations may be considered failures to meet LTC users' basic care needs.[4] Since HCBS recipients are an increasing proportion of elderly LTC users, it is important to understand what factors are associated with potentially

preventable hospitalizations among them. Studies that have explored potentially preventable hospitalizations among HCBS users examined a limited number of individual characteristics or examined enrollees in a managed care program, so they do not provide much insight into these hospitalizations among the broader population of HCBS recipients.[17, 34-37]

It is not clear whether the primary care needs of individuals using HCBS are met to avoid unnecessary hospitalizations and whether similar factors are related to potentially preventable hospitalizations among HCBS users as among nursing home residents. Specifically, the relationship between outpatient physician visits and potentially preventable hospitalizations is unknown for elderly LTC users. Nursing care and physician assessments are required components of nursing home care,[38, 39] and therefore, no studies of potentially preventable hospitalizations focusing on the nursing home population have examined whether outpatient physician visits are associated with potentially preventable hospitalizations. No studies focusing on HCBS users have analyzed this factor either, but outpatient physician visits may be a significant factor related to potentially preventable hospitalizations for HCBS recipients. It is believed that the conditions used to define potentially preventable hospitalizations could be treated at a lower level of care or prevented entirely given timely access to outpatient services. Typically, the main care providers for HCBS users are direct care workers, who have little formalized training in LTC tasks and generally do not have any skilled medical training.[38, 40] Having an outpatient physician visit, therefore, may be associated with a lower risk for a preventable hospitalization if individuals receive services that meet their

medical needs and are able to avoid unnecessary hospitalizations. Conversely, having an outpatient physician visit may alert providers to issues that are concerning, so individuals could be hospitalized for further testing or monitoring. Therefore, having an outpatient physician visit may be associated with a higher risk for a preventable hospitalization.

The aim of this analysis was to examine patient factors, including demographic and clinical factors, associated with potentially preventable hospitalizations among elderly Medicaid HCBS users. In particular, this analysis sought to examine the relationship between physician visits and potentially preventable hospitalizations among HCBS recipients.

Methods

Data Sources

The data for this analysis came from several sources, including seven state Medicaid offices (Arkansas, Florida, Minnesota, New Mexico, Texas, Vermont, and Washington), the Centers for Medicare and Medicaid Services (CMS), and the Health Resources and Services Administration (HRSA). The Medicaid and CMS data were available through a data reuse agreement.[b]

The Medicaid offices in AR, FL, MN, NM, TX, VT, and WA identified HCBS waiver and state plan recipients in their Medicaid programs for each month from 2002-2005 and provided "finder files" with these LTC recipients categorized on a monthly

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[b] The state Medicaid data, Medicaid claims, and Medicare claims were available through a data reuse agreement from a CMS contract to examine states' progress toward "rebalancing" their LTC programs to include more HCBS options. The seven states were chosen as part of the contract work because of their variation in financing for institutional and community LTC programs, as well as variation of other characteristics including size, population, demographics, geography, management, policy, and county government structure.

basis. Waiver recipients included enrollees in aged/physically disabled waivers, and LTC

state plan recipients included Medicaid beneficiaries that utilized home health or personal

care services.[c] The specific waivers and state plans for each state from which the study

population was identified for this analysis are listed in Appendix 1. The state "finder

files" contained the CMS Eligible Identifier Number and the CMS Health Insurance

Claim (HIC) number in order to link individuals to their Medicaid and Medicare claims

files; all data files were subsequently recoded with unique internal linking variables so

that all analyses were performed with de-identified datasets.

CMS provided the Medicaid and Medicare claims data for the seven states over

the 2002-2005 time period. CMS collects beneficiary, utilization, and payment

information from state Medicaid programs through its Medicaid Statistical Information

System (MSIS) and creates standardized Medicaid Analytic eXtract (MAX) files from

the state-submitted Medicaid data. The MAX files are created on a yearly basis for each

state. For this analysis, the MAX person summary (PS) files, which contain demographic

information, and the MAX utilization files, which include the MAX inpatient (IP) file,

the MAX long-term care (LT) file, and the MAX other services (OT) file, were linked to

the state "finder files" for the study population. Medicare claims for the dually eligible

individuals in the study population were also extracted and linked to the "finder files" and

Medicaid files. The Medicare files included the Medicare Denominator file, the Medicare

Provider Analysis and Review (MedPAR) file, the Outpatient, Home Health, and Hospice

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[c] Individuals coded as state plan recipients during a month were those who had state plan service utilization and were not enrolled in any HCBS waiver during that month. HCBS waiver recipients may have had state plan service utilization during a month, but they were coded as a HCBS waiver enrollee and their state plan utilization was retained in all records. The distinction between specific services is not relevant for the objectives of this analysis.

Institutional standard analytic files, and the Carrier Non-Institutional standard analytic files. The Area Resource File (ARF) from HRSA was also used to obtain county-level market factors.

Study Population

The study population included Medicaid fee-for-service (FFS) LTC users age 65 and older in AR, FL, MN, NM, TX, VT, and WA from 2003-2005. The data was analyzed at the person-quarter level, so the study population was defined as individuals age 65 and older who were classified as being in an aged/physically disabled HCBS waiver or as using home health or personal care state plan services for all three months during the person-quarter at time$_t$.

Variables

The outcome of interest in this analysis was a potentially preventable hospitalization. However, an individual could also experience a non-potentially preventable hospitalization or die, so these outcomes also needed to be taken into account. Therefore, a four-category outcome was defined as: (1) the individual experienced a potentially preventable hospitalization during the person-quarter at time$_{t+1}$ (identified by having a hospitalization with an ACS condition as the primary diagnosis); (2) the individual experienced a non-potentially preventable hospitalization during the person-quarter at time$_{t+1}$ (identified as having a hospitalization with a non-ACS condition as the primary diagnosis); (3) the individual died during the person-quarter at time$_{t+1}$ (without experiencing a hospitalization prior to death); (4) reference group (individual did not experience a hospitalization of any type and did not die). The ACS conditions

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identified by the primary diagnosis on the hospitalization claim included angina, asthma, cellulitis, chronic obstructive pulmonary disease, congestive heart failure, dehydration, diabetes mellitus, gastroenteritis, epilepsy, hypertension, hypoglycemia, urinary tract infection, pneumonia, and severe ear, nose, and throat infections. The ICD-9 codes used to identify ACS conditions are displayed in Appendix 2.

Since a potentially preventable hospitalization among HCBS recipients may be related to outpatient physician visits, a dummy variable indicating whether an individual had an evaluation and management outpatient physician visit in the person-quarter at time$_t$ was included to explore this factor. The procedure codes that were used to identify outpatient physician visits are listed in Appendix 3.

To explore demographic characteristics associated with potentially preventable hospitalizations, variables for age, gender, race/ethnicity, urban or rural residence, dual eligibility, and the reason for Medicaid eligibility were included. These variables were defined for the person-quarter at time$_t$. Age was included as a categorical variable. It was calculated for the person-quarter at time$_t$ and classified into one of six categories: age 65-70, age 71-75, age 76-80, age 81-85, age 86-90, and age 91 and older. Gender was classified as female or male and race/ethnicity was classified as White, Black, Hispanic, Asian, Native American, or Other. The MAX PS file contains beneficiaries' county of residence, and the urban or rural categorization for this analysis was based on the Metropolitan Statistical Area (MSA) classifications of counties as defined by the U.S. Office of Management and Budget (OMB). Dual eligibility was classified as dual-eligible

or Medicaid-only. The reason for Medicaid eligibility was classified as poverty/cash or medically needy/other.

Dummy variables for a number of diseases/conditions were included to examine clinical characteristics that may be associated with potentially preventable hospitalizations in this population. The diseases/conditions included anemia, anxiety, arthritis, cancer, chronic kidney disease, chronic obstructive pulmonary disease (COPD), dementia, depression, diabetes, heart failure, hypertension, ischemic heart disease, and stroke. These diseases/conditions were identified from diagnosis codes on claims with a look-back period of one year from the person-quarter at time$_t$, so an individual was coded as having a disease/condition if he or she had a diagnosis on any claim file from the previous year. The diagnosis codes to create the dummy variables for these disease/conditions can be found in Appendix 4. Since identification of the diseases/conditions used a look-back period of one year, 2002 claims were used for 2003 person-quarters.

Having a previous hospitalization also reflects health status, so a dummy variable indicating whether an individual had a hospitalization of any type during the person-quarters at time$_t$ or time$_{t-1}$ (i.e., in the six months prior to the outcome measure) was included; data from 2002 was used for a look-back period for the first person-quarter in 2003.

Variables reflecting market factors included the number of hospital beds per 1000 individuals age 65 and older and the per-capita income in an individual's county of residence; these variables came from the ARF. In addition to these variables, dummy

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variables for the component economic area of residence[d] and the quarter of the observation were included to control for unobserved factors.

Analysis

Since the dependent variable was a four-category outcome variable, a multinomial logit model was used. The multinomial logit model specifies that

$$p_{ij} = \frac{e^{\beta'_j x_i}}{\sum_{k=0}^m e^{\beta'_k x_i}}, \quad j = 0, \dots, m$$

where x_i are individual-specific regressors. The estimated equations provide a set of probabilities for the J+1 outcomes for an individual with characteristics x_i. In this model, individuals in the study population who experienced a potentially preventable hospitalization, experienced any other hospitalization, or died were each compared to individuals in the study population who did not experience any of these outcomes.[41] Relative-risk ratios for the model estimates were also computed, which gives the proportionate change in the relative risk of alternative j compared to alternative 1 when x_{ir} changes by one unit.[42] Cluster-robust standard errors by county were used to account for correlation between individuals within counties.

Because individual coefficient significance in a multinomial logit model varies with the reference category for comparison, Wald tests of the joint significance of each of the predictors were also performed to determine overall significance of the predictors.[42]

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[d] The Bureau of Economic Analysis (BEA) uses the U.S. Office of Management and Budget's (OMB) definitions of statistical areas to classify the regional markets surrounding metropolitan or micropolitan nodes. These economic areas classified by the BEA represent the relevant regional markets for labor, products, and information. The BEA uses labor commuting patterns to categorize labor markets and markets where businesses in the area sell their goods. The levels of regional hierarchy are counties, core-based statistical areas (metropolitan statistical areas and micropolitan statistical areas), combined statistical areas, component economic areas, and economic areas.

A number of sensitivity analyses were also performed to explore whether the results were consistent across different specifications of the model. These include (1) a redefined outcome variable using an alternative definition of a preventable hospitalization based on a CMS report[17] that distinguished a set of conditions that can be prevented/managed without hospitalization specifically for the home and community-based population (see Appendices 5-7); (2) a redefined outcome variable with individuals that experienced a hospitalization prior to death recoded as part of the death category rather than as part of the relevant hospitalization category as they were in the main analysis (see Appendices 8-9); and (3) a model with only the first observation per individual included in the analysis (see Appendices 10-11).

Results

Table 1 displays the characteristics of the study population. Approximately 4.3 percent of individuals experienced a potentially preventable hospitalization within a quarter during the study period, 9.7 percent of individuals experienced a non-potentially preventable hospitalization, 0.8 percent of individuals died, and 85.2 percent did not experience a hospitalization or die. The conditions that accounted for the majority of potentially preventable hospitalizations among this HCBS sample were congestive heart failure (27.4 percent), pneumonia (20.6 percent), chronic obstructive pulmonary disease (14.4 percent), urinary tract infections (12.6 percent), and dehydration (5.9 percent). About 77.7 percent of individuals had an outpatient physician visit during a quarter.

Results from the multinomial logit regression are shown in Table 2. Tests of joint significance indicated that all independent variables were statistically significant in

predicting the outcomes in this model except the number of hospital beds per 1000 age 65 and older in the county of residence and the per-capita income in the county of residence.

Several characteristics were significantly associated with experiencing a potentially preventable hospitalization. Individuals who had an outpatient physician visit in the quarter at $time_t$ had a 1.04 increased risk compared to individuals who did not have an outpatient physician visit of experiencing a potentially preventable hospitalization relative to no hospitalization/death in the quarter at $time_{t+1}$. Having a hospitalization in the six months prior to the quarter in which the outcome was measured was a strong predictor of whether an individual experienced a potentially preventable hospitalization. Individuals who had a hospitalization in the quarter at $time_t$ had a 2.09 increased risk compared to individuals who did not have a hospitalization of experiencing a potentially preventable hospitalization relative to no hospitalization/death in the quarter at $time_{t+1}$. All of the diseases/conditions were significant predictors of whether an individual experienced a potentially preventable hospitalization, but individuals with arthritis and hypertension had a decreased risk of experiencing a potentially preventable hospitalization relative to no hospitalization/death. Additionally, individuals who qualified for Medicaid based on medical need/other reasons had a significantly higher risk of experiencing a potentially preventable hospitalization relative to no hospitalization/death.

Factors associated with experiencing a non-potentially preventable hospitalization were mostly consistent with those for experiencing a potentially preventable hospitalization. Individuals who had an outpatient physician visit in the quarter at $time_t$

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had a 1.14 increased risk compared to individuals who did not have an outpatient physician visit of experiencing a non-potentially preventable hospitalization relative to no hospitalization/death in the quarter at time$_{t+1}$.

The predictors for dying differed somewhat from those for hospitalizations. Individuals who had an outpatient physician visit in the quarter at time$_t$ had a decreased risk compared to individuals who did not have an outpatient physician visit of dying relative to no hospitalization/death in the quarter at time$_{t+1}$. Specifically, they had a 0.53 decreased risk of dying relative to no hospitalization/death than individuals who did not have an outpatient physician visit. Having a hospitalization in the six months prior to the quarter in which the outcome was measured was a strong predictor of whether an individual died; individuals who had a previous recent hospitalization had a 3.40 increased risk of dying relative to no hospitalization/death than individuals who did not have a previous recent hospitalization. Individuals with a number of diseases/conditions had a decreased risk of dying relative to no hospitalization/death, including anxiety, arthritis, depression, diabetes, and hypertension.

Results from each of the sensitivity analyses exhibited similar patterns.

Discussion

The results indicate that potentially preventable hospitalizations were quite frequent among elderly Medicaid HCBS recipients, and a few conditions accounted for the majority of these hospitalizations. These results are consistent with previous analyses of HCBS users, which have found high rates of potentially preventable hospitalizations among this group of Medicaid recipients.[17, 37]

Several characteristics were associated with an increased risk for a potentially preventable hospitalization, including having a recent outpatient physician visit, having a recent hospitalization, and having a number of specific conditions such as COPD, heart failure, and ischemic heart disease. The significance of many predictors suggests that there is systematic variation in preventable hospitalizations among the elderly Medicaid HCBS population and improvements could be made in reducing this variation.

Other demographic characteristics, such as age and qualifying for Medicaid based on medical need, were found to be significant predictors of experiencing a potentially preventable hospitalization. Other analyses among nursing home residents, as well as one study of HCBS users, have found that rates of potentially preventable hospitalizations vary by certain individual characteristics.[13, 17, 28-30] It is possible that there is unmet need among subgroups of individuals, and these subgroups could be targeted to reduce their risk for a potentially preventable hospitalization.

Not surprisingly, individuals who had a hospitalization in the prior six months had an increased risk of all outcomes, including experiencing a potentially preventable hospitalization. Previous research has shown that transitions to and from hospitals are often inadequately coordinated and that individuals have a high risk of rehospitalization and poor health outcomes.[43] Improving transitions from the hospital to home and community-based settings is important to reduce hospitalizations among the HCBS population.

In addition to improving transitions to and from the hospital to reduce subsequent hospitalizations, it appears that better monitoring and coordination of outpatient services

is important among this population of LTC users in order to reduce hospitalizations. This analysis found that individuals who had an outpatient physician visit had an increased risk of experiencing a potentially preventable hospitalization. Although it is not entirely clear why individuals who had an outpatient physician visit would have an increased risk for a preventable hospitalization, it is possible that outpatient medical providers were alerted to issues that were concerning or uncertain and felt that a hospitalization was needed for further monitoring and testing. It is possible that more frequent and timely outpatient visits are needed to avoid a hospitalization. It is likely important for both caregivers and LTC providers to be involved with medical providers to ensure that the LTC recipients' chronic and acute needs are met on an ongoing basis. Individuals with a number of different specific diseases/conditions, such as COPD, heart failure, and ischemic heart disease, had increased risk of experiencing preventable hospitalizations, suggesting that these may be conditions to target and monitor closely.

As states continue to make HCBS a priority within their Medicaid programs, it is important to make certain that these LTC users' medical needs are met in addition to their LTC needs. Given the frequency of potentially preventable hospitalizations among elderly Medicaid HCBS recipients, it may be possible to reduce preventable hospitalizations among this population with improved outpatient care and coordination with caregivers, resulting in better health outcomes and possible savings for Medicaid and Medicare. Reducing preventable hospitalizations likely requires a more proactive approach toward primary medical care in the community.

There are a few limitations of this analysis to note. Medicaid programs vary by state, and these states may not be representative of all states. Due to commonly known data limitations on managed care enrollees, only FFS enrollees were included in the analysis. Managed care enrollees may have a different pattern of hospitalization than the FFS enrollees that were analyzed. Other characteristics may be important risk factors for hospitalizations among HCBS users, but a limited number of characteristics were available to examine. Lastly, the first event within a quarter was examined but not events or transitions over time for individuals. Multiple events and transitions may be particularly important for the study population since they are quite vulnerable.

Table 1: Sample Description of Elderly Medicaid Home and Community-based Long-term Care Users
(N = 1,245,181)

Variable	Mean (SD) or Percent
Outcome	
Potentially Preventable Hospitalization	4.27%
Non-Potentially Preventable Hospitalization	9.72%
Died	0.79%
None	85.22%
Characteristics	
Physician Visit	
No	22.32%
Yes	77.68%
Age	
65-70	21.04%
71-75	22.14%
76-80	22.48%
81-85	17.31%
86-90	11.11%
91+	5.93%
Gender	
Male	24.44%
Female	75.56%
Race	
White	48.53%
Black	15.19%
Hispanic	29.55%
Asian	1.91%
Native American	1.32%
Other	3.50%
Urban/Rural Residence	
Urban	69.84%
Rural	30.16%
Dual Eligible Status	
Medicaid-only	3.01%
Dual Eligible	96.99%
Reason for Medicaid Eligibility	
Poverty/Cash	49.36%
Medically Needy/Other	50.64%
Diagnosis	
Anemia	33.42%
Anxiety	8.57%
Arthritis	49.40%
Cancer	10.83%
Chronic Kidney Disease	14.54%
Chronic Obstructive Pulmonary Disease	25.34%
Dementia	17.50%
Depression	14.42%
Diabetes	41.45%

Table 1: Sample Description of Elderly Medicaid Home and Community-based Long-term Care Users
(N = 1,245,181)

Variable	Mean (SD) or Percent
Heart Failure	30.14%
Hypertension	73.22%
Ischemic Heart Disease	42.54%
Stroke	15.87%
Previous Hospitalization	
No	78.71%
Yes	21.29%
Number of Hospital Beds per 1000 Population Age 65+ in County (10s)	2.62 (1.98)
Per-Capita County Income (1000s)	25.52 (8.21)

Table 2: Predictors of Potentially Preventable Hospitalizations among Elderly Medicaid Home and Community-based Long-term Care Users - Multinomial Logit Results

Variable	Potentially Preventable Hospitalization				Non-Potentially Preventable Hospitalization				Died			
	Coef	**SE**	**RRR**	**95% CI**	**Coef**	**SE**	**RRR**	**95% CI**	**Coef**	**SE**	**RRR**	**95% CI**
Physician Visit												
No (reference)												
Yes	0.038*	0.016	1.038	1.006-1.072	0.129*	0.012	1.137	1.110-1.165	-0.639*	0.026	0.528	0.502-0.555
Age												
65-70 (reference)												
71-75	0.028	0.015	1.029	0.998-1.060	0.006	0.010	1.006	0.987-1.026	0.144*	0.038	1.155	1.071-1.245
76-80	0.042*	0.020	1.043	1.003-1.084	-0.005	0.013	0.995	0.970-1.020	0.259*	0.040	1.296	1.198-1.402
81-85	0.105*	0.024	1.111	1.061-1.164	0.010	0.013	1.010	0.984-1.036	0.405*	0.042	1.500	1.381-1.628
86-90	0.193*	0.031	1.213	1.141-1.289	0.058*	0.015	1.059	1.029-1.091	0.705*	0.050	2.025	1.836-2.233
91+	0.382*	0.027	1.465	1.398-1.546	0.150*	0.019	1.162	1.120-1.206	1.108*	0.052	3.028	2.737-3.351
Gender												
Male (reference)												
Female	-0.027	0.015	0.974	0.946-1.003	-0.050*	0.008	0.951	0.936-0.967	-0.276*	0.024	0.759	0.724-0.796
Race												
White (reference)												
Black	-0.111*	0.019	0.895	0.863-0.928	-0.084*	0.016	0.920	0.891-0.950	-0.174*	0.039	0.840	0.778-0.906
Hispanic	-0.022	0.016	0.979	0.949-1.009	-0.021	0.012	0.980	0.957-1.002	-0.115*	0.052	0.892	0.805-0.987
Asian	-0.230*	0.074	0.794	0.687-0.918	-0.191*	0.058	0.826	0.737-0.926	-0.285*	0.094	0.752	0.625-0.905
Native American	0.144*	0.056	1.155	1.036-1.288	0.109*	0.048	1.115	1.016-1.224	-0.016	0.107	0.985	0.798-1.215
Other	-0.114*	0.029	0.892	0.844-0.944	-0.067*	0.020	0.935	0.900-0.972	0.212*	0.060	1.236	1.099-1.390
Urban/Rural Residence												
Urban (reference)												
Rural	-0.066*	0.032	0.936	0.879-0.996	0.013	0.016	1.013	0.982-1.045	-0.204	0.043	0.815	0.749-0.887
Dual Eligible Status												
Medicaid-only (reference)												
Dual Eligible	0.050	0.046	1.052	0.961-1.150	0.115*	0.026	1.122	1.066-1.181	-0.269*	0.043	0.764	0.638-0.915
Reason for Medicaid Eligibility												

Table 2: Predictors of Potentially Preventable Hospitalizations among Elderly Medicaid Home and Community-based Long-term Care Users - Multinomial Logit Results

	Potentially Preventable Hospitalization				Non-Potentially Preventable Hospitalization				Died			
Poverty/Cash (reference)												
Medically Needy/Other	0.065*	0.013	1.068	1.040-1.096	0.116*	0.011	1.123	1.100-1.147	1.041*	0.090	2.833	2.374-3.380
Diagnosis												
Anemia	0.102*	0.012	1.107	1.082-1.133	0.244*	0.009	1.277	1.255-1.298	0.174*	0.024	1.190	1.134-1.248
Anxiety	0.170*	0.016	1.185	1.149-1.223	0.112*	0.010	1.118	1.096	-0.078	0.040	0.925	0.856
Arthritis	-0.070*	0.015	0.932	0.905-0.960	0.021*	0.010	1.021	1.001	-0.416*	0.023	0.660	0.631
Cancer	0.032*	0.015	1.032	1.003-1.063	0.181*	0.014	1.198	1.165	0.641*	0.028	1.899	1.799
Chronic Kidney Disease	0.277*	0.021	1.319	1.265-1.374	0.340*	0.011	1.405	1.374	0.534*	0.027	1.705	1.617
COPD	0.671*	0.014	1.956	1.903-2.011	0.157*	0.009	1.170	1.148	0.343*	0.030	1.410	1.329
Dementia	0.112*	0.016	1.118	1.084-1.153	0.145*	0.012	1.156	1.128	0.522*	0.024	1.686	1.608
Depression	0.067*	0.012	1.070	1.044-1.096	0.089*	0.010	1.093	1.073	-0.062	0.030	0.940	0.887
Diabetes	0.262*	0.012	1.299	1.269-1.330	0.129*	0.009	1.138	1.118	-0.083*	0.023	0.920	0.880
Heart Failure	0.602*	0.015	1.825	1.772-1.880	0.220*	0.009	1.246	1.224	0.403*	0.025	1.496	1.425
Hypertension	-0.100*	0.014	0.905	0.880-0.930	-0.014	0.010	0.986	0.968	-0.516*	0.030	0.597	0.563
Ischemic Heart Disease	0.222*	0.014	1.249	1.214-1.284	0.240*	0.009	1.272	1.249	0.047	0.023	1.048	1.003
Stroke	0.053*	0.016	1.055	1.022-1.089	0.184*	0.009	1.202	1.181	0.145*	0.028	1.156	1.095
Previous Hospitalization												
No (reference)												
Yes	0.736*	0.012	2.088	2.039-2.138	0.651*	0.012	1.917	1.874-1.962	1.223*	0.031	3.397	3.199-3.608
Number of hospital beds per 1000 population 65+ in county (10s)	0.004	0.005	1.004	0.995-1.013	0.006*	0.003	1.006	1.001-1.012	0.003	0.007	1.003	0.990-1.016

Table 2: Predictors of Potentially Preventable Hospitalizations among Elderly Medicaid Home and Community-based Long-term Care Users - Multinomial Logit Results

	Potentially Preventable Hospitalization				Non-Potentially Preventable Hospitalization				Died			
Per Capita County Income (1000s)	-0.006	0.003	0.994	0.988-1.001	-0.000	0.001	1.000	0.997-1.002	-0.002	0.004	0.998	0.991-1.005

Coef = Coefficient estimate; SE = Standard error; RRR = Relative risk ratio; 95% CI = 95% Confidence interval; COPD = Chronic Obstructive Pulmonary Disease

*p<0.05

Model also included categorical variables for quarter of observation and component economic area of residence

Age, race/ethnicity were jointly significant for each outcome; All variables except the number of hospital beds per 1000 population 65+ in county and per capita county income were jointly significant in the model

Chapter 4: Potentially Preventable Hospitalizations among Elderly Medicaid Home and Community-based Service Users Compared to Nursing Home Residents

Background

Elderly long-term care (LTC) users in both nursing homes and home and community-based settings often have complex needs that require support for functional and cognitive limitations, as well as medical care for acute and chronic conditions. These individuals are generally frail due to the combination of their support and medical needs, and thus, they have a high risk of hospitalization.[4, 18, 27] Studies have found that hospitalizations of frail elderly individuals are not only costly, but that they are often distressing and disruptive.[14, 15] Because of the potential health and financial consequences of hospitalizations, empirical research has focused on understanding hospitalizations of nursing home residents, and several patient, facility, and policy factors have been found to be associated with hospitalizations among this population.[18, 27]

While some hospitalizations may be necessary to treat conditions and symptoms and to restore function, certain hospitalizations may be unnecessary. Potentially preventable or potentially avoidable hospitalizations refer to hospitalizations that result from conditions or events that are thought to be avoidable altogether or manageable in an individual's current setting with access to medical and outpatient services.[20] Most empirical studies have examined all hospitalizations of nursing home residents, but a subset of studies has examined potentially preventable hospitalizations.[13, 16, 28-30] These studies have found that potentially preventable hospitalizations are frequent among nursing home residents, and a number of resident and facility characteristics are

associated with them, indicating that these hospitalizations differed across characteristics and improvements could be made to reduce these differences. Given the empirical evidence, a number of policy initiatives have been implemented to focus on hospitalizations among nursing home residents. For instance, the Medicare-Medicaid Coordination Office in collaboration with the Center for Medicare and Medicaid Innovation are soliciting proposals due in June 2012 for organizations and partnering nursing facilities to participate in a demonstration project with the goal of reducing preventable hospitalizations among nursing facility residents (see https://www.cms.gov/Medicare-Medicaid-Coordination/Medicare-and-Medicaid-Coordination/Medicare-Medicaid-Coordination-Office/ReducingPreventableHospitalizationsAmongNursingFacilityResidents.html). Although attention has been focused on the nursing home population, less is known about potentially preventable hospitalizations among elderly home and community-based service (HCBS) users.

There has been a substantial increase in LTC delivered through HCBS over the last several decades due to consumers' and family members' preferences for care in home and community settings, concerns about the cost and quality of nursing home care, and court rulings such as the Olmstead Supreme Court decision that require alternatives to institutional care.[3, 9] States have made varying efforts to create a more balanced LTC system with HCBS options as alternatives to nursing home care.[1, 3] With this investment in HCBS, most types of LTC needs can be met in a number of alternative settings, often through a combination of different support services. How an individuals' LTC needs are

met within their setting may impact how their acute and chronic care needs are met and potentially preventable hospitalizations may be considered failures to meet LTC users' basic care needs, regardless of where they are receiving their care.[4] The only studies that have explored potentially preventable hospitalizations among HCBS users examined a limited number of individual characteristics or examined enrollees in a managed care program, so they do not provide much insight into these hospitalizations among HCBS recipients.[17, 34-36]

It is not obvious how the risk for a potentially preventable hospitalization among HCBS users might compare to nursing home residents since there may be offsetting factors. Nursing homes tend to have a more medical model of care than HCBS since it has a reliance on professional nursing staff, care available 24 hours per day, and required assessments at regular intervals along with a physician contact.[39] Nursing home staff play a central role in medical decisions regarding residents. HCBS tends to rely more on direct-care workers or paraprofessional staff, often with assistance from informal caregivers, to provide many support services, and there are no standard requirements for HCBS programs for ongoing assessments or physician visits.[38, 40, 44] The medical orientation of nursing home care may lead nursing home residents to have a lower risk for a preventable hospitalization compared to HCBS users if their acute and LTC needs are better coordinated and met, if conditions are recognized at an earlier stage so fewer serious events occur, and if staff have the resources and training to treat residents within the nursing home setting and can avoid a hospital transfer.

Alternatively, more staff resources may need to be devoted to caring for residents who have an event or an exacerbation of an existing condition, and nursing homes may not have an incentive to do so. Under current payment policy, nursing homes are not financially penalized for hospitalizing a resident and in cases where bed-hold policies are in place, nursing homes are paid to hold the bed for a Medicaid resident who is hospitalized. Therefore, nursing homes may decide to hospitalize a patient rather than devote the necessary resources to his or her care within the nursing home setting. Nursing homes may also be fearful of litigation from residents or family members. If a nursing home chooses to treat a resident within the facility rather than hospitalize him or her and his or her condition worsens, the nursing home may be subject to legal recourse.[12, 19, 45] These incentives may lead to nursing home residents to have a higher risk for a preventable hospitalization compared to HCBS users because these factors may not create the same incentives within home and community settings. With the increases in the numbers of elderly individuals served through HCBS, it is important to better understand hospitalizations among these LTC users.

The aim of this analysis was to compare the risk for a potentially preventable hospitalization between elderly Medicaid HCBS recipients and nursing home residents.

Methods

Data Sources

The data for this analysis came from several sources, including seven state Medicaid offices (Arkansas, Florida, Minnesota, New Mexico, Texas, Vermont, and Washington), the Centers for Medicare and Medicaid Services (CMS), the Health

Resources and Services Administration (HRSA), and the Census Bureau. The Medicaid and CMS data were available through a data reuse agreement.[e]

The Medicaid offices in AR, FL, MN, NM, TX, VT, and WA identified HCBS waiver and state plan recipients in their Medicaid programs for each month from 2002-2005 and provided "finder files" with these LTC recipients categorized on a monthly basis. Waiver recipients included enrollees in aged/physically disabled waivers, and LTC state plan recipients included Medicaid beneficiaries that utilized home health, personal care, or nursing home services.[f] The specific waivers and state plans for each state from which the study population was identified for this analysis are listed in Appendix 1. The state "finder files" contained the CMS Eligible Identifier Number and the CMS Health Insurance Claim (HIC) number in order to link individuals to their Medicaid and Medicare claims files; all data files were subsequently recoded with unique internal linking variables so that all analyses were performed with de-identified datasets.

CMS provided the Medicaid and Medicare claims data for the seven states over the 2002-2005 time period. CMS collects beneficiary, utilization, and payment information from state Medicaid programs through its Medicaid Statistical Information System (MSIS) and creates standardized Medicaid Analytic eXtract (MAX) files from

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[e] The state Medicaid data, Medicaid claims, and Medicare claims were available through a data reuse agreement from a CMS contract to examine states' progress toward "rebalancing" their LTC programs to include more HCBS options. The seven states were chosen as part of the contract work because of their variation in financing for institutional and community LTC programs, as well as variation of other characteristics including size, population, demographics, geography, management, policy, and county government structure.
[f] Individuals coded as state plan recipients during a month were those who had state plan service utilization and were not enrolled in any HCBS waiver during that month. HCBS waiver recipients may have had state plan service utilization during a month, but they were coded as a HCBS waiver enrollee and their state plan utilization was retained in all records. The distinction between specific services is not relevant for the objectives of this analysis.

the state-submitted Medicaid data. The MAX files are created on a yearly basis for each state. For this analysis, the MAX person summary (PS) files, which contain demographic information, and the MAX utilization files, which include the MAX inpatient (IP) file, the MAX long-term care (LT) file, and the MAX other services (OT) file, were linked to the state "finder files" for the study population. Medicare claims for the dually eligible individuals in the study population were also extracted and linked to the "finder files" and Medicaid files. The Medicare files included the Medicare Denominator file, the Medicare Provider Analysis and Review (MedPAR) file, the Outpatient, Home Health, and Hospice Institutional standard analytic files, and the Carrier Non-Institutional standard analytic files.

The Area Resource File (ARF) from HRSA was used to obtain county-level market factors, and County Business Patterns data from the Census Bureau were used for information on county-level employment by industry.

Study Population

The study population included Medicaid fee-for-service (FFS) LTC users age 65 and older in AR, FL, MN, NM, TX, VT, and WA from 2003-2005. The data was analyzed at the person-quarter level. The HCBS population was defined as individuals age 65 and older who were identified by the states as being in an aged/physically disabled HCBS waiver or as using home health or personal care state plan services for all three months during the person-quarter at time$_t$. The nursing home population was defined as individuals age 65 and older who were identified by the states as using nursing facility state plan services for all three months during the person-quarter at time$_t$.

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Variables

The outcome of interest in this analysis was a potentially preventable hospitalization. However, an individual could also experience a non-potentially preventable hospitalization or die, so these outcomes also needed to be taken into account. Therefore, a four-category outcome was defined as: (1) the individual experienced a potentially preventable hospitalization during the person-quarter at time$_{t+1}$ (identified by having a hospitalization with an ACS condition as the primary diagnosis); (2) the individual experienced a non-potentially preventable hospitalization during the person-quarter at time$_{t+1}$ (identified as having a hospitalization with a non-ACS condition as the primary diagnosis); (3) the individual died during the person-quarter at time$_{t+1}$ (without experiencing a hospitalization prior to death); (4) reference group (individual did not experience a hospitalization of any type and did not die). The ACS conditions identified by the primary diagnosis on the hospitalization claim included angina, asthma, cellulitis, chronic obstructive pulmonary disease, congestive heart failure, dehydration, diabetes mellitus, gastroenteritis, epilepsy, hypertension, hypoglycemia, urinary tract infection, pneumonia, and severe ear, nose, and throat infections. The ICD-9 codes used to identify ACS conditions are displayed in Appendix 2.

The independent variable of interest for this analysis was an individual's type of LTC, defined by HCBS use or nursing home use during the person-quarter at time$_t$. A number of variables to control for demographic characteristics were included in the analysis. These include variables for age, gender, race/ethnicity, urban or rural residence, dual eligibility, and the reason for Medicaid eligibility. These variables were defined for

the person-quarter at time$_t$. Age was included as a categorical variable. It was calculated for the person-quarter at time$_t$ and classified into one of six categories: age 65-70, age 71-75, age 76-80, age 81-85, age 86-90, and age 91 and older. Gender was classified as female or male and race/ethnicity was classified as White, Black, Hispanic, Asian, Native American, or Other. The MAX PS file contains beneficiaries' county of residence, and the urban or rural categorization for this analysis was based on the Metropolitan Statistical Area (MSA) classifications of counties as defined by the U.S. Office of Management and Budget (OMB). Dual eligibility was classified as dual-eligible or Medicaid-only. The reason for Medicaid eligibility was classified as poverty/cash or medically needy/other.

Dummy variables for a number of diseases/conditions were included to control for clinical characteristics that may be associated with potentially preventable hospitalizations in this population. The diseases/conditions included anemia, anxiety, arthritis, cancer, chronic kidney disease, chronic obstructive pulmonary disease, dementia, depression, diabetes, heart failure, hypertension, ischemic heart disease, and stroke. These diseases/conditions were identified from diagnosis codes on claims with a look-back period of one year from the person-quarter at time$_t$, so an individual was coded as having a disease/condition if he or she had a diagnosis on any claim file from the previous year. The diagnosis codes to create the dummy variables for these disease/conditions can be found in Appendix 4. Since identification of the diseases/conditions used a look-back period of one year, 2002 claims were used for 2003 person-quarters.

Having a previous hospitalization also reflects health status, so a dummy variable indicating whether an individual had a hospitalization of any type during the person-quarters at time$_t$ or time$_{t-1}$ (i.e., in the 6 months prior to the outcome measure) was included; data from 2002 was used for a look-back period for the first person-quarter in 2003.

Control variables reflecting market factors included the number of hospital beds per 1000 individuals age 65 and older and the per-capita income in an individual's county of residence; these variables came from the ARF. In addition to these variables, dummy variables for the component economic area of residence[g] and the quarter of the observation were included to control for unobserved factors.

Analysis

The independent variable of interest in this analysis was an individual's type of LTC defined by HCBS or nursing home use. In addition to measurable differences, there were likely to be unmeasured differences between individuals that were correlated with their type of LTC use as well as with their outcome, so the coefficient results from a naïve regression model would be biased if no correction was made. In order to correct for this endogeneity, an instrumental variables (IV) approach was used to estimate the effect of interest and to obtain unbiased results. For IV, the instrument must be highly correlated with the variable of interest but not directly affect the outcome of interest; the

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[g] The Bureau of Economic Analysis (BEA) uses the U.S. Office of Management and Budget's (OMB) definitions of statistical areas to classify the regional markets surrounding metropolitan or micropolitan nodes. These economic areas classified by the BEA represent the relevant regional markets for labor, products, and information. The BEA uses labor commuting patterns to categorize labor markets and markets where businesses in the area sell their goods. The levels of regional hierarchy are counties, core-based statistical areas (metropolitan statistical areas and micropolitan statistical areas), combined statistical areas, component economic areas, and economic areas.

exogenous variation in the independent variable of interest that is produced by the instrument is used to identify the estimates.[46]

The instruments for this analysis, which are described in more detail in Appendix 12, were the number of employees per 1000 population age 65 and older in an individual's county of residence for each year from 2003-2005 in the following industry classes: (1) home health care services, which includes employees that deliver care such as home health, personal care, and homemaker services in the home; (2) homes for the elderly, which includes employees that deliver personal care and services in residential settings; (3) services for the elderly and persons with disabilities, which includes employees that deliver nonresidential social services such as adult day care; and (4) nursing care facilities which includes employees that deliver services in nursing homes. These instruments were constructed from the Census Bureau's County Business Patterns and linked to observations by county and year. Since these instruments reflect the availability of HCBS and nursing home services in an individual's area of residence, they should be highly correlated with whether an individual is an HCBS or nursing home user. These instruments do not measure the type of employee in the specified industry classes such as nurse practitioners versus certified nursing assistants, nor do they measure the total number of hours worked; rather, they measure overall quantity of employees, so they should not be directly correlated with the outcome (i.e., whether an individual experiences a hospitalization or death).

Because the dependent variable was a four-category outcome variable, a multinomial logit model was used for the analysis. Typical linear IV methods, such as

two-stage least squares, would be biased for this nonlinear relationship, so two-stage residual inclusion was used to estimate the IV model instead.[47] In two-stage residual inclusion, the endogenous variables in the second-stage equation are not replaced by the predicted values from the first-stage; rather, the residuals from the first-stage are included as regressors in the second-stage. Specifically, for the first stage of this analysis, the potentially endogenous LTC group variable (G_i) was regressed on all of the exogenous variables (X_i) and the instruments (Z_i) with a logit model:

$$\Pr(G_i) = \alpha_0 + X_i\alpha_1 + Z_i\alpha_2 + e_i$$

The α's are the estimated coefficient parameters and the $\hat{e}_i$'s are the predicted residuals. In the second stage, the outcome (Y_{ij}) was regressed on all of the exogenous variables (X_i), the endogenous LTC group variable (G_i), and the predicted residuals from the first stage ($\hat{e}_i$) with a multinomial logit model:

$$\Pr(Y_{ij}) = \beta_0 + X_i\beta_1 + G_i\beta_2 + \hat{e}_i\beta_3 + \varepsilon_i$$

The second stage gives the β's, which are the unbiased coefficient parameters.[47, 48]

Cluster-robust standard errors by county were used to account for correlation between individuals within counties. Bootstrapping of the first and second stages was used to obtain the standard errors.

A number of sensitivity analyses were also performed to explore whether the results were consistent across different specifications of the model. These include (1) a redefined outcome variable using an alternative definition of a preventable hospitalization based on a CMS report[17] that distinguished a set of conditions that can be prevented/managed without hospitalization specifically for the home and community-

based population (see Appendices 6, 13-14); (2) a propensity score analysis using inverse probability weighting (see Appendix 15); (3) a redefined outcome variable with individuals that experienced a hospitalization prior to death recoded as part of the death category rather than as part of the relevant hospitalization category as they were in the main analysis (see Appendices 16-17); (4) a model with only the first observation per individual included in the analysis (see Appendices 18-20); and (5) a model excluding the previous hospitalization control variable (see Appendices 21-22).

Results

Descriptive statistics are shown in Table 3. HCBS recipients had a slightly higher unadjusted frequency of both potentially preventable and non-potentially preventable hospitalizations and a lower frequency of death compared to nursing home residents. For nursing home residents, the conditions that accounted for the majority of potentially preventable hospitalizations included pneumonia (30.7 percent), urinary tract infection (24.0 percent), congestive heart failure (17.9 percent), chronic obstructive pulmonary disease (7.1 percent), and dehydration (6.6 percent); for HCBS users they included congestive heart failure (27.4 percent), pneumonia (20.6 percent), chronic obstructive pulmonary disease (14.4 percent), urinary tract infections (12.6 percent), and dehydration (5.9 percent).

Results from the naïve regression model, which corrected for characteristics and case-mix but not endogeneity, are found in Table 4. HCBS users had a 1.36 increased risk compared to nursing home residents for a potentially preventable hospitalization relative to no hospitalization/death. They had a 1.32 increased risk compared to nursing home

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residents for a non-potentially preventable hospitalization relative to no hospitalization/death and a 0.44 decreased risk compared to nursing home residents for dying relative to no hospitalization/death. For each of these outcomes, the type of LTC was significant.

Results from the first and second stages of the instrumental variable model are presented in Tables 5 and 6, respectively. In Table 5, the nursing home group is the reference group, so the model predicts HCBS use. The coefficients for each of the instruments were in the expected direction. Three of the instruments were individually significant, and the F-test of joint significance of the instruments was 76.56 (p = 0.0000), indicating that they were jointly significant. The results were robust to the inclusion of different sets of instruments.

Overall, the results from the second stage of the IV model, presented in Table 6, show that after controlling for endogeneity, the coefficient results get larger. HCBS users had a 1.45 increased risk compared to nursing home residents for a potentially preventable hospitalization relative to no hospitalization/death, a 1.39 increased risk compared to nursing home residents for a non-potentially preventable hospitalization relative to no hospitalization/death, and a 0.45 decreased risk compared to nursing home residents for dying relative to no hospitalization/death.

Sensitivity analyses indicated similar results. Appendices 13 and 14 display results using an alternative definition of a preventable hospitalization based on a CMS report[17] which defined a separate list of conditions that may be more appropriate for HCBS users. In order to examine whether the main results were driven by conditions that

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may not actually be preventable or manageable among the HCBS population, this definition was applied for both HCBS users and nursing home residents. This may provide a more comparable definition of a preventable hospitalization, although it is a conservative definition for the nursing home population. The most notable difference between this alternative set of conditions and the ACS conditions used for the main analyses is the omission of pneumonia in the alternative set. The unadjusted frequency in Appendix 13 shows that HCBS users more frequently experienced a potentially preventable hospitalization than did nursing home residents. Appendix 14 presents the second stage IV results. HCBS users had a 1.58 increased risk compared to nursing home residents for a potentially preventable hospitalization relative to no hospitalization/death, a 1.36 increased risk compared to nursing home residents for a non-potentially preventable hospitalization relative to no hospitalization/death, and a 0.45 decreased risk compared to nursing home users of death relative to no hospitalization/death.

The propensity score analysis using inverse probability weighting, as well as the other sensitivity analyses, showed internally consistent results. In all of these analyses, HCBS users had a higher risk of both potentially preventable and non-potentially preventable hospitalizations and a lower risk of death relative to no hospitalization/death compared to nursing home residents.

Discussion

The five most frequent conditions accounting for preventable hospitalizations were the same for HCBS users and nursing home residents, although the rank order was different. These results are consistent with previous research that has found a few main

conditions to account for the majority of preventable hospitalizations.[16, 17] This suggests that it may be most valuable to initially concentrate on care and interventions for a specific set of conditions, rather than focusing on all at once, to reduce preventable hospitalizations. Focusing on specific conditions should reduce these hospitalizations among both HCBS and nursing home users.

Overall, HCBS users had an increased risk compared to nursing home residents for a preventable hospitalization relative to remaining alive without a hospitalization. HCBS users also had an increased risk compared to nursing home residents for a non-potentially preventable hospitalization. The results were consistent across several specifications of the model, including after controlling for endogeneity.

Given that after controlling for many characteristics and correcting for endogeneity, HCBS users had an increased risk for a preventable hospitalization compared to nursing home residents, the results indicate that there is a significant effect of the setting in which an individual receives their LTC and improvements may be able to be made in reducing this effect. Previous research has not explicitly examined the role of LTC setting in the risk for a potentially preventable hospitalization, so these results provide valuable information to policymakers looking for ways to reduce hospitalizations and improve outcomes, particularly among dual eligibles. The increased risk among HCBS users compared to nursing home residents is likely related to the medical care that is provided within the nursing home setting, which results in fewer events and different treatment of events when they do occur. Policies, such as the use of advance directives within a nursing home, may also result in different treatment of events. It is important

that further initiatives to reduce hospitalizations should not just focus on nursing home residents, but they should focus on HCBS users as well since these individuals also have a significant risk for hospitalization. More proactive medical care may be needed for individuals in home and community settings in order to reduce hospitalizations among this population.

Distinguishing between conditions or events that are prevented and those that are treated within the setting without transfer to a hospital is currently difficult because there are no specific measures of event rates. With most available data, this distinction cannot be made, so it is not clear whether nursing homes are more frequently preventing the incidence of these conditions or events or whether these events are occurring and nursing homes are treating them within the facility more frequently. However, this is important to disentangle, particularly in the context of providing payments or incentives for medical care that is delivered in the nursing home or other outpatient settings which subsequently reduce hospital transfers.

There are a number of policy issues around payment approaches and incentives related to these results. First, as states have more flexibility and opportunities under the Affordable Care Act to provide HCBS, it is important for them to think about ways to integrate both medical and LTC for individuals with LTC needs because they are interrelated. While there are a few programs for dual eligibles that currently do this, these programs are not widespread and are limited in enrollment. New models of care for Medicare beneficiaries, including accountable care organizations (ACOs), aim to increase coordination across providers by requiring the organizations to take financial

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responsibility for their set of patients across all settings.[49] ACOs may be a way to integrate medical and LTC for individuals with LTC needs. As these models grow in the future, research should address whether all the needs of LTC users can be met by the providers within these organizations and what the best way is to include Medicaid within this model. A shared savings approach for both Medicare and Medicaid providers within an ACO may be a way to integrate the care of Medicaid LTC users.[37]

Payment reforms, such as bundled payments, may also incentivize providers to improve coordination of care and transitions across different settings. If states implement payment reforms, they need to think carefully about the potential conflicting incentives that could arise in order to minimize the cost-shifting between Medicare and Medicaid that is likely at play for dual eligibles within the current system. A number of demonstration projects supported by the Medicare-Medicaid Coordination Office within CMS are underway to understand how to better align the financial incentives between Medicare and Medicaid for dual eligibles (see https://www.cms.gov/Medicare-Medicaid-Coordination/Medicare-and-Medicaid-Coordination/Medicare-Medicaid-Coordination-Office/). Results from these demonstration projects may provide insight into payment models that reduce cost-shifting between Medicare and Medicaid.

Better communication and coordination between providers may allow more timely primary care and lower intensity interventions to prevent exacerbation of events. This includes communication with the LTC providers in the community and the patient about their needs and preferences, as well as with informal care providers who often play a critical role in HCBS users' overall health and well-being by providing support services

in addition to more medical tasks such as medication management. Ongoing assessment for the HCBS population may also help care providers become aware of issues and unmet need in order to intervene prior to a transfer to a hospital.

There are a few limitations of this analysis to note. Medicaid programs vary by state, and the states used in this analysis may not be representative of all states. Due to commonly known data limitations on managed care enrollees, only FFS enrollees were included in the analysis. Managed care enrollees may have a different pattern of hospitalizations than the FFS enrollees that were analyzed. A limited number of control variables were included in the models; this limited the examination of different mediators of the effect of the type of LTC use. It is also not known whether the adjustment for selection was adequate. Lastly, the first event within a quarter was examined but individuals' transitions over time were not examined. Transitions may be particularly important for the study population as they may transfer between different settings quite frequently.

Table 3: Sample Description of Elderly Medicaid Nursing Home and Home and Community-based Long-term Care Users

Variable	Mean (SD) or Percent	
	Nursing Home (N = 1,089,573)	HCBS (N = 1,245,181)
Outcome		
Potentially Preventable Hospitalization	3.69%	4.27%
Non-Potentially Preventable Hospitalization	8.71%	9.72%
Died	3.34%	0.79%
None	84.25%	85.22%
Characteristics		
Age		
65-70	9.85%	21.04%
71-75	13.23%	22.14%
76-80	19.31%	22.48%
81-85	22.37%	17.31%
86-90	20.07%	11.11%
91+	15.17%	5.93%
Gender		
Male	24.93%	24.44%
Female	75.07%	75.56%
Race		
White	74.88%	48.53%
Black	12.78%	15.19%
Hispanic	8.70%	29.55%
Asian	0.50%	1.91%
Native American	0.58%	1.32%
Other	2.57%	3.50%
Urban/Rural Residence		
Urban	72.50%	69.84%
Rural	27.50%	30.16%
Dual Eligible Status		
Medicaid-only	2.23%	3.01%
Dual Eligible	97.77%	96.99%
Reason for Medicaid Eligibility		
Poverty/Cash	16.43%	49.36%
Medically Needy/Other	83.57%	50.64%
Diagnosis		
Anemia	50.00%	33.42%
Anxiety	11.78%	8.57%
Arthritis	39.65%	49.40%
Cancer	8.97%	10.83%
Chronic Kidney Disease	13.09%	14.54%
Chronic Obstructive Pulmonary Disease	24.01%	25.34%
Dementia	62.42%	17.50%
Depression	35.55%	14.42%
Diabetes	35.81%	41.45%
Heart Failure	41.45%	30.14%
Hypertension	69.13%	73.22%
Ischemic Heart Disease	41.72%	42.54%

Table 3: Sample Description of Elderly Medicaid Nursing Home and Home and Community-based Long-term Care Users

Variable	Mean (SD) or Percent	
	Nursing Home (N = 1,089,573)	**HCBS (N = 1,245,181)**
Stroke	30.06%	15.87%
Previous Hospitalization		
No	80.83%	78.71%
Yes	19.17%	21.29%
Number of Hospital Beds per 1000 Population Age 65+ in County (10s)	2.59 (2.09)	2.62 (1.98)
Per-Capita County Income (1000s)	29.16 (7.24)	25.52 (8.21)

All variables significantly different at $p < 0.05$

Table 4: Potentially Preventable Hospitalizations among Elderly Medicaid Home and Community-based Users Compared with Nursing Home Residents - Multinomial Logit Results from Uncorrected Model

Variable	Potentially Preventable Hospitalization				Non-Potentially Preventable Hospitalization				Died			
	Coef	**SE**	**RRR**	**95% CI**	**Coef**	**SE**	**RRR**	**95% CI**	**Coef**	**SE**	**RRR**	**95% CI**
Long-term Care Group												
Nursing Home (reference)												
HCBS	0.309*	0.020	1.363	1.309-1.418	0.276*	0.019	1.318	1.270-1.368	-0.815*	0.032	0.442	0.416-0.471
Age												
65-70 (reference)												
71-75	0.029*	0.013	1.029	1.004-1.056	0.010	0.009	1.010	0.991-1.028	0.204*	0.024	1.226	1.170-1.285
76-80	0.053*	0.016	1.055	1.023-1.088	-0.009	0.011	0.991	0.971-1.012	0.416*	0.022	1.516	1.453-1.581
81-85	0.095*	0.019	1.100	1.060-1.141	-0.005	0.012	0.995	0.972-1.018	0.610*	0.023	1.840	1.761-1.924
86-90	0.143*	0.024	1.153	1.100-1.209	0.007	0.013	1.007	0.982-1.032	0.842*	0.024	2.321	2.216-2.431
91+	0.219	0.027	1.244	1.180-1.312	-0.014	0.017	0.986	0.954-1.019	1.186*	0.023	3.275	3.127-3.429
Gender												
Male (reference)												
Female	-0.048*	0.009	0.953	0.935-0.971	-0.128	0.008	0.880	0.866-0.893	-0.241*	0.013	0.786	0.766-0.806
Race												
White (reference)												
Black	-0.074*	0.019	0.929	0.896-0.963	0.000	0.012	1.000	0.976-1.025	-0.298*	0.025	0.742	0.707-0.779
Hispanic	-0.009	0.015	0.991	0.963-1.020	0.025*	0.012	1.025	1.002-1.049	-0.264*	0.033	0.768	0.719-0.820
Asian	-0.147*	0.066	0.863	0.758-0.982	-0.094	0.051	0.910	0.824-1.005	-0.527*	0.073	0.590	0.511-0.681
Native American	0.207*	0.057	1.230	1.099-1.376	0.179*	0.033	1.196	1.121-1.275	-0.069	0.090	0.933	0.782-1.113
Other	-0.059*	0.024	0.943	0.900-0.987	-0.024	0.017	0.976	0.945-1.009	0.054	0.034	1.055	0.987-1.128
Urban/Rural Residence												
Urban (reference)												
Rural	-0.056	0.032	0.945	0.888-1.006	0.050*	0.017	1.052	1.017-1.087	-0.092*	0.028	0.912	0.863-0.964
Dual Eligible Status												
Medicaid-only (reference)												
Dual Eligible	-0.007	0.035	0.993	0.928-1.063	0.070*	0.024	1.072	1.023-1.124	-0.315*	0.057	0.730	0.652-0.817
Reason for Medicaid Eligibility												

Table 4: Potentially Preventable Hospitalizations among Elderly Medicaid Home and Community-based Users Compared with Nursing Home Residents - Multinomial Logit Results from Uncorrected Model

	Potentially Preventable Hospitalization				Non-Potentially Preventable Hospitalization				Died			
Poverty/Cash (reference)												
Medically Needy/Other	0.070*	0.013	1.072	1.044-1.101	0.087*	0.012	1.091	1.065-1.117	0.584*	0.070	1.793	1.562-2.059
Diagnosis												
Anemia	0.092*	0.010	1.097	1.076-1.118	0.201*	0.008	1.223	1.203-1.243	0.083*	0.013	1.087	1.059-1.115
Anxiety	0.129*	0.012	1.138	1.112-1.165	0.083*	0.007	1.087	1.071-1.103	-0.077*	0.016	0.926	0.897-0.955
Arthritis	-0.057*	0.012	0.944	0.923-0.966	0.007	0.009	1.007	0.990-1.024	-0.261*	0.012	0.770	0.752-0.789
Cancer	0.042*	0.012	1.042	1.019-1.067	0.150*	0.012	1.162	1.134-1.189	0.309*	0.018	1.362	1.315-1.409
Chronic Kidney Disease	0.267*	0.017	1.306	1.263-1.351	0.330*	0.009	1.390	1.366-1.415	0.436*	0.015	1.546	1.500-1.593
COPD	0.580*	0.012	1.785	1.743-1.828	0.171*	0.008	1.187	1.169-1.205	0.183*	0.014	1.201	1.169-1.234
Dementia	0.027	0.015	1.027	0.997-1.058	0.062*	0.013	1.064	1.037-1.091	0.259*	0.014	1.296	1.260-1.332
Depression	0.045*	0.009	1.046	1.028-1.066	0.051*	0.008	1.052	1.036-1.068	-0.093*	0.012	0.911	0.889-0.933
Diabetes	0.248*	0.009	1.282	1.259-1.305	0.142*	0.007	1.152	1.136-1.168	-0.055*	0.011	0.947	0.927-0.967
Heart Failure	0.510*	0.014	1.665	1.618-1.712	0.196*	0.007	1.217	1.199-1.234	0.245*	0.012	1.277	1.246-1.309
Hypertension	-0.018	0.011	0.982	0.962-1.003	0.041*	0.008	1.042	1.025-1.058	-0.306*	0.014	0.736	0.716-0.757
Ischemic Heart Disease	0.202*	0.010	1.224	1.201-1.248	0.202*	0.007	1.224	1.206-1.242	0.035*	0.011	1.036	1.014-1.058
Stroke	0.076*	0.011	1.079	1.055-1.102	0.152*	0.010	1.164	1.141-1.186	0.094*	0.012	1.099	1.073-1.125
Previous Hospitalization												
No (reference)												
Yes	0.722*	0.010	2.060	2.020-2.100	0.671*	0.008	1.956	1.927-1.986	1.018*	0.017	2.769	2.678-2.863
Number of hospital beds per 1000 population 65+ in county (10s)	0.007	0.004	1.007	0.999-1.016	0.009*	0.003	1.009	1.004-1.015	-0.008	0.005	0.992	0.983-1.001
Per Capita County Income (1000s)	-0.010*	0.003	0.991	0.986-0.995	-0.001	0.001	0.999	0.997-1.001	-0.002	0.003	0.998	0.993-1.003

Coef = Coefficient estimate; SE = Standard error; RRR = Relative risk ratio; 95% CI = 95% Confidence interval; COPD = Chronic Obstructive Pulmonary Disease
*p<0.05
Model also included categorical variables for quarter of observation and component economic area of residence

Table 5: Potentially Preventable Hospitalizations among Elderly Medicaid Home and Community-based Users Compared with Nursing Home Residents - First Stage Logit Results for Instrumental Variable Model

Variable	Coefficient	Standard Error
Instruments		
Home Health Care Services Employees per 1000 population 65+ in county	0.0005*	0.0001
Homes for the Elderly Employees per 1000 population 65+ in county	0.0006	0.0029
Services for the Elderly and Persons with Disabilities Employees per 1000 population 65+ in county	0.0032*	0.0007
Nursing Home Employees per 1000 population 65+ in county	-0.0047*	0.0007
Age		
65-70 (reference)		
71-75	-0.1427*	0.0215
76-80	-0.3679*	0.0270
81-85	-0.5965*	0.0332
86-90	-0.8592*	0.0340
91+	-1.2438*	0.0423
Gender		
Male (reference)		
Female	0.3677*	0.0187
Race		
White (reference)		
Black	0.7630*	0.0945
Hispanic	0.8297*	0.0378
Asian	0.5159*	0.1558
Native American	0.4032*	0.1888
Other	0.5930*	0.0989
Urban/Rural Residence		
Urban (reference)		
Rural	-0.0289	0.0467
Dual Eligible Status		
Medicaid-only (reference)		

Table 5: Potentially Preventable Hospitalizations among Elderly Medicaid Home and Community-based Users Compared with Nursing Home Residents - First Stage Logit Results for Instrumental Variable Model

Variable	Coefficient	Standard Error
Dual Eligible	0.6656*	0.1008
Reason for Medicaid Eligibility		
Poverty/Cash (reference)		
Medically Needy/Other	-1.6536*	0.0877
Diagnosis		
Anemia	-0.7377*	0.0320
Anxiety	-0.0116	0.0232
Arthritis	0.4431*	0.0256
Cancer	0.3937*	0.0171
Chronic Kidney Disease	0.1319*	0.0246
COPD	0.3151*	0.0294
Dementia	-1.8437*	0.0334
Depression	-1.0108*	0.0321
Diabetes	-0.1109*	0.0165
Heart Failure	-0.5422*	0.0413
Hypertension	0.3413*	0.0267
Ischemic Heart Disease	0.3157*	0.0164
Stroke	-0.6227*	0.0242
Previous Hospitalization		
No (reference)		
Yes	0.6612*	0.0187
Number of hospital beds per 1000 population 65+ in county (10s)	0.0076	0.0077
Per Capita County Income (1000s)	-0.0313*	0.0045

COPD = Chronic Obstructive Pulmonary Disease
*p<0.05
Model also included categorical variables for quarter of observation and component economic area of residence

Table 6: Potentially Preventable Hospitalizations among Elderly Medicaid Home and Community-based Users Compared with Nursing Home Residents – Second Stage Multinomial Logit Results for Instrumental Variable Model

Variable	Potentially Preventable Hospitalization				Non-Potentially Preventable Hospitalization				Died			
	Coef	**SE**	**RRR**	**95% CI**	**Coef**	**SE**	**RRR**	**95% CI**	**Coef**	**SE**	**RRR**	**95% CI**
Long-term Care Group												
Nursing Home (reference)												
HCBS	0.374*	0.017	1.453	1.406-1.502	0.332*	0.011	1.394	1.363-1.426	-0.797*	0.028	0.451	0.427-0.476
Residual from first stage	-0.026*	0.005	0.974	0.965-0.984	-0.023*	0.003	0.978	0.971-0.984	-0.008	0.008	0.992	0.977-1.008
Age												
65-70 (reference)												
71-75	0.030*	0.011	1.031	1.009-1.053	0.010	0.008	1.011	0.995-1.026	0.204*	0.024	1.227	1.171-1.285
76-80	0.056*	0.011	1.058	1.036-1.080	-0.006	0.007	0.994	0.980-1.008	0.417*	0.023	1.517	1.451-1.585
81-85	0.100*	0.011	1.105	1.081-1.129	-0.002	0.007	0.998	0.985-1.012	0.611*	0.022	1.843	1.765-1.924
86-90	0.150*	0.012	1.162	1.134-1.190	0.013	0.008	1.013	0.998-1.029	0.844*	0.023	2.326	2.222-2.434
91+	0.229*	0.013	1.258	1.227-1.289	-0.005	0.009	0.995	0.977-1.013	1.189*	0.024	3.285	3.136-3.440
Gender												
Male (reference)												
Female	-0.052*	0.008	0.949	0.935-0.965	-0.131*	0.006	0.877	0.867-0.888	-0.242*	0.012	0.785	0.766-0.804
Race												
White (reference)												
Black	-0.081*	0.012	0.922	0.902-0.944	-0.005	0.007	0.995	0.981-1.009	-0.300*	0.017	0.741	0.716-0.766
Hispanic	-0.016	0.039	0.984	0.964-1.005	0.019*	0.009	1.019	1.001-1.038	-0.266*	0.021	0.766	0.736-0.798
Asian	-0.150*	0.039	0.860	0.798-0.928	-0.097*	0.024	0.908	0.866-0.952	-0.528*	0.064	0.590	0.520-0.669
Native American	0.203*	0.045	1.162	1.134-1.190	0.175*	0.031	1.192	1.122-1.265	-0.071	0.064	0.932	0.822-1.056
Other	-0.066*	0.021	1.258	1.227-1.289	-0.029	0.016	0.971	0.941-1.002	0.052*	0.026	1.053	1.001-1.109
Urban/Rural Residence												
Urban (reference)												
Rural	-0.056*	0.011	0.945	0.926-0.965	0.051*	0.007	1.052	1.038-1.066	-0.092*	0.015	0.912	0.886-0.939
Dual Eligible Status												
Medicaid-only (reference)												
Dual Eligible	-0.015	0.025	0.985	0.938-1.035	0.062*	0.018	1.064	1.027-1.104	-0.318*	0.031	0.728	0.685-0.773
Reason for Medicaid												

Table 6: Potentially Preventable Hospitalizations among Elderly Medicaid Home and Community-based Users Compared with Nursing Home Residents – Second Stage Multinomial Logit Results for Instrumental Variable Model

	Potentially Preventable Hospitalization				Non-Potentially Preventable Hospitalization				Died			
Eligibility												
Poverty/Cash (reference)												
Medically Needy/Other	0.085*	0.009	1.088	1.069-1.109	0.100*	0.006	1.105	1.092-1.118	0.588*	0.014	1.801	1.752-1.852
Diagnosis												
Anemia	0.099*	0.007	1.104	1.089-1.119	0.207*	0.005	1.230	1.217-1.243	0.085*	0.010	1.089	1.068-1.109
Anxiety	0.129*	0.010	1.138	1.116-1.161	0.083*	0.007	1.087	1.072-1.102	-0.077*	0.015	0.926	0.899-0.954
Arthritis	-0.061*	0.007	0.941	0.928-0.954	0.004	0.006	1.004	0.993-1.015	-0.262*	0.010	0.769	0.754-0.785
Cancer	0.038*	0.011	1.039	1.016-1.062	0.146*	0.007	1.158	1.142-1.173	0.308*	0.017	1.360	1.316-1.405
Chronic Kidney Disease	0.266*	0.008	1.304	1.284-1.325	0.328*	0.007	1.388	1.370-1.406	0.435*	0.012	1.545	1.509-1.582
COPD	0.577*	0.008	1.780	1.752-1.808	0.168*	0.005	1.183	1.172-1.195	0.182*	0.012	1.200	1.173-1.228
Dementia	0.047*	0.010	1.048	1.028-1.068	0.079*	0.007	1.083	1.068-1.097	0.265*	0.013	1.303	1.270-1.337
Depression	0.055*	0.009	1.057	1.038-1.076	0.059*	0.006	1.061	1.049-1.072	-0.091*	0.011	0.913	0.894-0.933
Diabetes	0.249*	0.007	1.283	1.265-1.301	0.142*	0.005	1.153	1.141-1.165	-0.054*	0.011	0.947	0.926-0.968
Heart Failure	0.514*	0.007	1.672	1.650-1.695	0.200*	0.006	1.222	1.209-1.235	0.246*	0.011	1.279	1.252-1.307
Hypertension	-0.021*	0.010	0.980	0.961-0.998	0.039*	0.007	1.039	1.026-1.053	-0.307*	0.012	0.736	0.719-0.753
Ischemic Heart Disease	0.199*	0.008	1.221	1.201-1.240	0.200*	0.006	1.221	1.207-1.235	0.034*	0.012	1.035	1.011-1.060
Stroke	0.081*	0.008	1.085	1.069-1.101	0.156*	0.005	1.169	1.157-1.182	0.096*	0.012	1.100	1.076-1.126
Previous Hospitalization												
No (reference)												
Yes	0.716*	0.008	2.047	2.016-2.078	0.666*	0.006	1.946	1.924-1.968	1.017*	0.011	2.764	2.707-2.822
Number of hospital beds per 1000 population 65+ in county (10s)	0.007*	0.002	1.007	1.004-1.011	0.009*	0.001	1.009	1.007-1.012	-0.008*	0.003	0.992	0.987-0.997
Per Capita County Income (1000s)	-0.009*	0.001	0.991	0.989-0.992	-0.001	0.001	0.999	0.998-1.000	-0.002	0.001	0.998	0.996-1.000

Coef = Coefficient estimate; SE = Standard error; RRR = Relative risk ratio; 95% CI = 95% Confidence interval; COPD = Chronic Obstructive Pulmonary Disease

*p<0.05

Model also included categorical variables for quarter of observation and component economic area of residence

Chapter 5: Hospitalizations among Elderly Medicaid Long-term Care Users Who Transition from Nursing Homes

Background

Individuals of all ages with long-term care (LTC) needs have expressed a preference to be served in home and community settings whenever possible.[50-53] In addition to the preference for noninstitutional care, the per-person costs are generally lower for home and community-based services (HCBS) than for nursing home services, making them appealing to state Medicaid programs looking for ways to be more cost-effective in delivering LTC.[2, 3, 54] Many state Medicaid programs have been working to change the institutional bias in Medicaid by providing more HCBS to individuals with LTC needs.[1, 3]

In order to meet the goal of shifting the balance of LTC toward more HCBS, states have structured their Medicaid LTC programs in various ways and generally use two strategies: (1) diversion and (2) transition. A few states have created an approach that generally allows individuals to choose their LTC setting and to receive the necessary services within that setting. These approaches intend to keep individuals who do not wish to be institutionalized and who can be served in home and community settings out of nursing homes from the start. Some states have specific programs, often called diversion programs, which aim to identify individuals at risk of long-term nursing home placement and to provide HCBS to keep them out of a nursing home. Other states largely use nursing homes as the first entry point into the Medicaid LTC system, so individuals do not necessarily have the choice of HCBS initially, but it may be possible for these

individuals to access HCBS after a period of time in the LTC system. Many states have also instituted transition programs to move long-stay nursing home residents into home and community settings.[52]

"Long-stay" nursing home residents are typically residents who remain in the nursing home for greater than 90 days. Most individuals are discharged within 90 days of a nursing home admission, but individuals who remain longer than 90 days have a low likelihood of being discharged and often end up living in the nursing home for many months or years.[55-57] Some of these individuals who become long-stay nursing home residents prefer to be in a home or community setting and could reasonably be cared for in one of those settings. Additionally, some individuals' conditions, preferences, and circumstances change over time, so even if they need or prefer nursing home care initially, they may wish to move to a home or community setting after a period of time. A number of recent policies at the federal and state-level have been implemented to help Medicaid-eligible individuals who have resided in a nursing home for an extended period of time move into home and community settings if they wish to do so. These transition policies aim to reduce the number of long-stay nursing home residents.[52, 58-60]

Previous studies have focused on the factors predicting whether or not an individual will transition to the community after they are admitted to the nursing home.[57, 58, 61-64] Other research has examined the likelihood of, and factors related to, readmission to the nursing home after an individual is discharged to the community.[59, 60] The findings from these studies point to a number of factors that providers and case managers can

focus on to improve transitions and to keep individuals in the community once they have transitioned out of a nursing home.

These results are important as states attempt to make further progress in keeping individuals out of nursing homes and providing more HCBS. However, the outcomes of individuals after they are discharged to the community are also important, but research has largely not examined how individuals fare once they have moved into home and community settings after a long stay in a nursing home. Aside from reinstitutionalization, other relevant outcomes are unknown. The national Money Follows the Person demonstration, which is a large federal grant program to help states move long-stay individuals out of institutions, is collecting data on individuals who transition under the program.[60] However, the evaluation is focusing on how long individuals stay in the community, how they rate their quality of care/quality-of-life, and reinstitutionalization rates. Other outcomes, such as hospitalizations, are not being evaluated.

Hospitalizations among transition populations are an important outcome to understand. The organization and emphasis of medical care is different in the nursing home compared with home and community settings. Nursing homes have a reliance on professional nursing staff, care available 24 hours per day, and required assessments at regular intervals along with a physician contact.[39] HCBS tends to rely more on direct-care workers or paraprofessional staff, often with assistance from informal caregivers, to provide many support services, and there are no standard requirements for HCBS programs for ongoing assessments or physician visits.[38, 40, 44]

Not only does the model of care change when an individual transitions out of the nursing home, but the set of care providers also changes. HCBS recipients must become familiar with new LTC providers, and they may also have new medical care providers for their chronic and acute needs. Since there tends to be little formal coordination among LTC and medical care providers, the continuity of care may not be adequate to meet HCBS users' needs. Individuals who remain in the nursing home will likely have a more continuous set of providers and a set schedule of visits and assessments.

The change in the model of care, as well as the continuity and coordination of care, may increase the risk of hospitalization for individuals who transition out of the nursing home after an extended period of time. There are numerous possible health concerns resulting from hospitalizations among this population. There is also the possible increased risk for reentering a nursing home after a hospitalization and for additional decline due to transfers between multiple settings within a short period of time.

This analysis assessed the risk factors for hospitalizations among individuals who transition to home and community LTC settings after an extended nursing home stay and individuals who remain in the nursing home and compared the risk for hospitalization between these groups.

Methods

Data Sources

The data for this analysis came from several sources, including seven state Medicaid offices (Arkansas, Florida, Minnesota, New Mexico, Texas, Vermont, and

Washington) and the Centers for Medicare and Medicaid Services (CMS). The Medicaid and CMS data were available through a data reuse agreement.[h]

The Medicaid offices in AR, FL, MN, NM, TX, VT, and WA identified HCBS waiver and state plan recipients in their Medicaid programs for each month from 2002-2005 and provided "finder files" with these LTC recipients categorized on a monthly basis. Waiver recipients included enrollees in aged/physically disabled waivers, and LTC state plan recipients included Medicaid beneficiaries that utilized home health, personal care, or nursing home services.[i] The specific waivers and state plans for each state from which the study population was identified for this analysis are listed in Appendix 1. The state "finder files" contained the CMS Eligible Identifier Number and the CMS Health Insurance Claim (HIC) number in order to link individuals to their Medicaid and Medicare claims files; all data files were subsequently recoded with unique internal linking variables so that all analyses were performed with de-identified datasets.

CMS provided the Medicaid and Medicare claims data for the seven states over the 2002-2005 time period. CMS collects beneficiary, utilization, and payment information from state Medicaid programs through its Medicaid Statistical Information System (MSIS) and creates standardized Medicaid Analytic eXtract (MAX) files from

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[h] The state Medicaid data, Medicaid claims, Medicare claims, and MDS files were available through a data reuse agreement from a CMS contract to examine states' progress toward "rebalancing" their LTC programs to include more HCBS options. The seven states were chosen as part of the contract work because of their variation in financing for institutional and community LTC programs, as well as variation of other characteristics including size, population, demographics, geography, management, policy, and county government structure.

[i] Individuals coded as state plan recipients during a month were those who had state plan service utilization and were not enrolled in any HCBS waiver during that month. HCBS waiver recipients may have had state plan service utilization during a month, but they were coded as a HCBS waiver enrollee and their state plan utilization was retained in all records. The distinction between specific services is not relevant for the objectives of this analysis.

the state-submitted Medicaid data. The MAX files are created on a yearly basis for each state. For this analysis, the MAX person summary (PS) files, which contain demographic information, and the MAX utilization files, which include the MAX inpatient (IP) file, the MAX long-term care (LT) file, and the MAX other services (OT) file, were linked to the state "finder files" for the study population. Medicare claims for the dually eligible individuals in the study population were also extracted and linked to the "finder files" and Medicaid files. The Medicare files included the Medicare Denominator file, the Medicare Provider Analysis and Review (MedPAR) file, the Outpatient, Home Health, and Hospice Institutional standard analytic files, and the Carrier Non-Institutional standard analytic files.

CMS provided the Minimum Data Set (MDS) files for individuals in these seven states for 2003-2005. All residents in Medicare or Medicaid certified nursing facilities are required to have standardized assessments that are part of the MDS; the assessments occur at admission and quarterly thereafter, with additional assessments performed when there is a significant change in status. The MDS measures health status and physical, cognitive, psychological, and social functioning of residents and includes information on resident demographic characteristics.

Study Population

The study population included dual eligible fee-for-service (FFS) beneficiaries age 65 and older in AR, FL, MN, NM, TX, VT, and WA from 2003-2005. In order to obtain as close to an admission sample as possible, individuals had to be admitted to a nursing home during 2003, 2004, or 2005 with no prior nursing home stay recorded

within the past five years. These individuals had to have a length of stay in the nursing home greater than 90 days, and these stays were paid for by Medicaid.

After these exclusions were applied, the "nursing home stayers" included individuals who were not discharged to the community during the study period. The "nursing home transitioners" included individuals who were discharged at any time after 90 days to the community with no expectation of readmission to the nursing home and who received Medicaid HCBS (waiver or community state plan services) beginning within the month after discharge. Individuals who were discharged to the community but did not receive Medicaid HCBS within the month after discharge were not included in the analysis in order to focus on LTC users.

Individuals in the nursing home transitioner group were matched to an individual in the nursing home stayer group based on their long-form Activities of Daily Living (ADL), Cognitive Performance Scale (CPS), and Chronic Illness and Disability Payment Score[j] (CDPS) scores, year of nursing home admission, age, gender, urban/rural residence, reason for Medicaid eligibility, and race. Propensity score matching was the matching method used for this analysis. Specifically, one-to-one nearest neighbor matching with no replacement and common support (i.e., excluding "treatment" observations whose propensity score is higher than the maximum or less than the minimum propensity score of the "controls") was used to implement the propensity score

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[j] The Chronic Illness and Disability Payment System (CDPS) is a diagnostic classification system developed as a tool for state Medicaid programs. This system includes 20 major categories of diagnoses corresponding to body systems or type of diagnosis; most categories are divided into several subcategories according to the degree of the increased expenditures associated with diagnoses. The CDPS system creates a score that can be used for payment and profiling purposes. The CDPS is similar to the Hierarchical Condition Category (HCC) model.

matching. All characteristics used for matching were calculated at the time of nursing home admission. The ADL and CPS scores are described in more detail in Appendices 23-24. The characteristic distribution after matching and the common support graph are presented in Appendices 25-26.

Variables

The outcome of interest in this analysis was the first potentially preventable hospitalization. This was identified by an individual having a hospitalization with an ACS condition as the primary diagnosis. The ACS conditions identified by the primary diagnosis on the hospitalization claim included angina, asthma, cellulitis, chronic obstructive pulmonary disease, congestive heart failure, dehydration, diabetes mellitus, gastroenteritis, epilepsy, hypertension, hypoglycemia, urinary tract infection, pneumonia, and severe ear, nose, and throat infections. The ICD-9 codes used to identify ACS conditions are displayed in Appendix 2.

The independent variable of interest for this analysis was an individual's group, defined by being either a nursing home stayer or a nursing home transitioner. A number of other independent variables were included. These variables were defined at the time of, or closest to, right censoring. Variables to control for demographic characteristics included variables for age, gender, race/ethnicity, urban or rural residence, and the reason for Medicaid eligibility. Age was included as a categorical variable and classified into one of six categories: age 65-70, age 71-75, age 76-80, age 81-85, age 86-90, and age 91 and older. Gender was classified as female or male and race/ethnicity was classified as White, Black, Hispanic, Asian, Native American, or Other. The MAX PS file contains

beneficiaries' county of residence, and the urban or rural categorization for this analysis was based on the Metropolitan Statistical Area (MSA) classifications of counties as defined by the U.S. Office of Management and Budget (OMB). The reason for Medicaid eligibility was classified as poverty/cash or medically needy/other.

Dummy variables for a number of diseases/conditions were included to control for clinical characteristics that may be associated with potentially preventable hospitalizations in this population. The diseases/conditions included anemia, anxiety, arthritis, cancer, chronic kidney disease, chronic obstructive pulmonary disease, dementia, depression, diabetes, heart failure, hypertension, ischemic heart disease, and stroke. These diseases/conditions were identified from diagnosis codes on claims with a look-back period of one year, so an individual was coded as having a disease/condition if he or she had a diagnosis on any claim file from the previous year. The diagnosis codes to create the dummy variables for these disease/conditions can be found in Appendix 4. Since identification of the diseases/conditions used a look-back period of one year, 2002 claims were used for 2003 person-quarters.

The ADL and CPS scores from the most recent MDS assessment were also included to control for physical and cognitive function. For the nursing home transitioners, these scores were calculated at the time closest to their discharge date.

Analysis

The start of analysis time for nursing home transitioners began at the date of discharge to Medicaid HCBS. The start of analysis time for nursing home stayers was set to the start date of their matched individual in the nursing home transitioner group. The

event of interest in this analysis was the first potentially preventable hospitalization

experienced, and censoring of data could occur due to death or end of follow-up.

In order to adjust for the differing time at risk for experiencing a potentially

preventable hospitalization and for the censoring of data, a Cox proportional hazards

regression model was used to estimate the impact of the independent variables on the

time to a potentially preventable hospitalization. The Cox proportional hazards model is a

semiparametric survival model, which accounts for time at risk and censoring events. In

the Cox proportional hazards model, the hazard rate for experiencing a potentially

preventable hospitalization (conditional on having survived to time t) for the jth subject is

defined as

$$h(t|x_j) = h_0(t)\exp(x_j\beta_x)$$

where the β_x's are the regression coefficients that are estimated from the data. The hazard

ratio is obtained from this model. For subjects j and m with characteristics x_j and x_m,

respectively, the hazard ratio is

$$\frac{h(t|x_j)}{h(t|x_m)} = \frac{\exp(x_j\beta_x)}{\exp(x_m\beta_x)}$$

which is constant.[65] Inverse probability weighting using the estimated propensity score

was used in the Cox proportional hazards models comparing nursing home transitioners

with nursing home stayers.

Additional analyses were performed to further explore hospitalizations among the

sample. These include (1) examining any type of hospitalization (Appendices 27-29); and

(2) examining potentially preventable and any type of hospitalizations for individuals

with heart failure or ischemic heart disease (Appendices 30-33).

Results

Nursing home stayers and nursing home transitioners were similar across the distribution of characteristics used for matching defined at the time of nursing home admission for each of the groups (see Appendices 25-26). Analysis sample characteristics are presented in Table 7. Out of the final matched sample used in the analysis, there were 113 potentially preventable hospitalizations among the nursing home stayers (9.7 percent of the sample had an event) and 133 potentially preventable hospitalizations among the nursing home transitioners (11.4 percent of the sample had an event). Of the 1,056 individuals in the nursing home stayer group who did not experience an event, 12 were censored due to death, and of the 1,036 individuals in the nursing home transitioner group who did not experience an event, 61 were censored due to death. There were some differences between groups in the covariates used in the adjusted analysis, most notably for some of the clinical characteristics.

Tables 8 and 9 show the predictors of experiencing a potentially preventable hospitalization for the nursing home stayer and nursing home transitioner groups. Most characteristics included in the models were not significant predictors of experiencing a potentially preventable hospitalization. For the nursing home stayer group, individuals with chronic kidney disease, with COPD and with heart failure had a significantly increased hazard of experiencing a potentially preventable hospitalization compared with individuals without each of these conditions. Specifically, having chronic kidney disease increased the hazard of experiencing a potentially preventable hospitalization by 72 percent compared to not having chronic kidney disease, having COPD increased the

hazard of experiencing a potentially preventable hospitalization by 90 percent compared with not having COPD, and having heart failure increased the hazard of experiencing a potentially preventable hospitalization by 56 percent compared with not having heart failure. Among the nursing home transitioners, having COPD was a significant predictor of experiencing a potentially preventable hospitalization. Having COPD increased the hazard by 198 percent compared with not having COPD.

Results from the adjusted Cox proportional hazards model for potentially preventable hospitalizations are found in Table 10. After adjusting for other characteristics, being in the nursing home transitioner group increased the hazard of experiencing a potentially preventable hospitalization by 29 percent compared with being in the nursing home stayer group, but this estimate was not statistically significant (hazard ratio, 1.29; 95 percent confidence interval, 0.969-1.72). Figure 1 shows the estimated cumulative hazard by group. Other characteristics in the full sample that significantly predicted the hazard of experiencing a potentially preventable hospitalization included the reason for Medicaid eligibility, COPD, and heart failure.

Results from the adjusted Cox proportional hazards model examining all hospitalizations (found in Appendix 23) indicate that being in the nursing home transitioner group significantly increased the hazard of experiencing any type of hospitalization. Specifically, being in the nursing home transitioner group increased the hazard of experiencing any type of hospitalization by 53 percent (hazard ratio, 1.53; 95 percent confidence interval, 1.29-1.82) compared with being in the nursing home stayer group.

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Among individuals with heart failure, being in the nursing home transitioner group compared with being in the nursing home stayer group increased the hazard of experiencing a potentially preventable hospitalization or any type of hospitalization, but the estimate was not significant for experiencing a potentially preventable hospitalization (see Appendices 26-27). The same pattern was found in the results for individuals with ischemic heart disease (see Appendices 28-29).

Discussion

In the full sample, nursing home transitioners had an increased (non-significant) hazard compared with nursing home stayers of experiencing a potentially preventable hospitalization. The nursing home transitioners had a significantly increased hazard compared with nursing home stayers of experiencing any type of hospitalization.

These results imply that transitioning to home and community-based LTC after an extended stay in the nursing home may increase an individual's risk for hospitalization. While mortality was not separately examined, the number of individuals who died during the follow-up period without experiencing an event was greater for the nursing home transitioners than for the nursing home stayers (61 versus 12 respectively), suggesting that an individual's risk of dying may also increase after transitioning out of the nursing home. Taken together, these results indicate that transitioning to home or community settings after an extended stay in the nursing home may be risky for older Medicaid recipients with LTC needs.

It is not clear whether the medical care or the continuity of care in the nursing home drives the decreased risk of hospitalization (and possibly mortality) for individuals

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who remain in the nursing home, but both of these factors are likely important. Individuals with LTC needs tend to have complex medical conditions in addition to support needs. Receiving timely medical care is important for these individuals because they can decline rapidly if issues are not addressed promptly. Having a consistent set of providers that are familiar with them and that they can access as issues arise is also important so that they do not go to the hospital unnecessarily.

As more investment is made in transition programs, it is important that policymakers and program staff recognize the potential for adverse outcomes after a transition. Most of the attention in LTC transition programs has been focused on nursing home readmission, but individuals who transition out of the nursing home may have increased risk of other outcomes such as hospitalizations. In addition to examining a more comprehensive set of outcomes for transitioners, it is important for transition programs to focus on ways to improve and ease individuals' transitions over time and not just at the time of the move. Housing and LTC providers are obvious priorities to arrange for individuals who transition, but coordinating adequate medical care should also be a priority to ensure that individuals receive care for all of their needs. Incorporating programs that integrate LTC and medical care as part of transition initiatives may lead to better overall care for transitioning individuals. Counseling or case management, as well as frequent follow-up with transitioners, could help address access problems or unmet needs before they lead to the use of more intensive services or to decline.

Among the nursing home stayers, having chronic kidney disease, COPD, and heart failure were significant predictors of experiencing a potentially preventable

hospitalization, while among the nursing home transitioners, having COPD was a significant predictor of experiencing a potentially preventable hospitalization. This suggests that while there some differences in the predictors of potentially preventable hospitalizations among these two groups of individuals, there were not many differences, and they seem primarily to relate to clinical characteristics. Focusing on individuals with these conditions may decrease hospitalizations among the populations.

There are a few limitations of this analysis to note. First, only the first hospitalization was examined. It is possible that individuals may cycle in and out of the hospital, nursing home, and home and community settings multiple times, but no conclusions can be made about these patterns. It is not known what role the specific home or community setting (e.g., an individual's home versus group setting) may play in the risk for a hospitalization. The sample was narrowed down by a number of characteristics, which limits the generalizability of the results. Lastly, only a small number of control variables were used in the analysis. While a matched sample was used with inverse probability weighting in the analysis, no further corrections were made for selection, so there is some potential for selection bias in the results.

Table 7: Sample Description of Elderly Medicaid Nursing Home Stayers and Nursing Home Transitioners

Variable	Mean (SD) or Percent	
	Nursing Home Stayers (N = 1,169)	Nursing Home Transitioners (N = 1,169)
Event		
Potentially Preventable Hospitalization	113 events/ 385,608 time at risk 9.67% had event	133 events/ 335,577 time at risk 11.38% had event
Characteristics		
Age		
65-70	8.21%	9.75%
71-75	15.57%	16.51%
76-80	22.33%	22.93%
81-85	24.89%	20.87%*
86-90	15.91%	18.99%
91+	13.09%	10.95%
Gender		
Male	24.98%	27.29%
Female	75.02%	72.71%
Race		
White	77.25%	73.31%*
Black	9.67%	10.18%
Hispanic	10.35%	13.69%*
Other	2.74%	2.82%
Urban/Rural Residence		
Urban	72.63%	71.86%
Rural	27.37%	28.14%
Reason for Medicaid Eligibility		
Poverty/Cash	13.52%	16.25%
Medically Needy/Other	86.48%	83.75%
Diagnosis		
Anemia	52.27%	51.07%
Anxiety	13.52%	14.71%
Arthritis	41.92%	50.98%*
Cancer	10.01%	13.52%
Chronic Kidney Disease	15.83%	24.21%*
Chronic Obstructive Pulmonary Disease	24.21%	32.93%*
Dementia	58.77%	53.81%*
Depression	42.60%	38.67%
Diabetes	40.29%	41.15%
Heart Failure	41.49%	51.24%*
Hypertension	76.39%	85.63%*
Ischemic Heart Disease	42.86%	55.18%*
Stroke	30.03%	36.44%*
Most recent Activities of Daily Living score	11.57 (8.35)	9.21 (8.06)*
Most recent Cognitive Performance Scale score	2.06 (1.51)	1.73 (1.41)*

*Significantly different at p<0.05

Table 8: Potentially Preventable Hospitalizations among Nursing Home Stayers – Cox Proportional Hazards Model Results

(N = 1,169)

Variable	Hazard Ratio [95% Confidence Interval]
Age*	
65-70 (reference)	
71-75	0.582 [0.291-1.164]
76-80	0.585 [0.304-1.125]
81-85	0.697 [0.367-1.324]
86-90	0.278* [0.114-0.680]
91+	0.268* [0.106-0.680]
Gender	
Male (reference)	
Female	1.388 [0.873-2.208]
Race	
White (reference)	
Black	1.023 [0.525-1.990]
Hispanic	1.033 [0.541-1.974]
Other	2.410 [0.942-6.166]
Urban/Rural Residence	
Urban (reference)	
Rural	0.908 [0.585-1.411]
Reason for Medicaid Eligibility	
Poverty/Cash (reference)	
Medically Needy/Other	1.461 [0.773-2.763]
Diagnosis	
Anemia	0.928 [0.617-1.397]
Anxiety	0.953 [0.557-1.633]
Arthritis	0.970 [0.655-1.437]
Cancer	0.627 [0.300-1.314]
Chronic Kidney Disease	1.719* [1.083-2.730]
Chronic Obstructive Pulmonary Disease	1.897* [1.253-2.873]
Dementia	0.821 [0.543-1.242]
Depression	1.054 [0.709-1.565]
Diabetes	1.238 [0.820-1.868]
Heart Failure	1.556* [1.027-2.358]
Hypertension	1.090 [0.645-1.842]
Ischemic Heart Disease	1.172 [0.777-1.767]
Stroke	0.793 [0.515-1.221]
Activities of Daily Living score	1.010 [0.986-1.036]
Cognitive Performance Scale score	0.897 [0.773-1.039]

*p<0.05

Table 9: Potentially Preventable Hospitalizations among Nursing Home Transitioners – Cox Proportional Hazards Model Results
(N = 1,169)

Variable	Hazard Ratio [95% Confidence Interval]
Age	
65-70 (reference)	
71-75	1.090 [0.565-2.102]
76-80	1.147 [0.601-2.191]
81-85	1.023 [0.518-2.018]
86-90	0.685 [0.326-1.441]
91+	0.480 [0.197-1.172]
Gender	
Male (reference)	
Female	1.337 [0.877-2.038]
Race	
White (reference)	
Black	1.260 [0.673-2.362]
Hispanic	1.312 [0.781-2.206]
Other	2.178 [0.823-5.762]
Urban/Rural Residence	
Urban (reference)	
Rural	1.103 [0.744-1.633]
Reason for Medicaid Eligibility	
Poverty/Cash (reference)	
Medically Needy/Other	1.919* [1.073-3.430]
Diagnosis	
Anemia	0.782 [0.539-1.135]
Anxiety	1.106 [0.675-1.811]
Arthritis	0.944 [0.658-1.353]
Cancer	0.863 [0.504-1.477]
Chronic Kidney Disease	1.151 [0.759-1.745]
Chronic Obstructive Pulmonary Disease	2.298* [1.595-3.312]
Dementia	0.863 [0.580-1.283]
Depression	1.071 [0.725-1.583]
Diabetes	1.101 [0.750-1.617]
Heart Failure	1.447 [0.973-2.151]
Hypertension	0.649 [0.392-1.074]
Ischemic Heart Disease	1.317 [0.899-1.928]
Stroke	1.240 [0.857-1.796]
Activities of Daily Living score	1.018 [0.993-1.043]
Cognitive Performance Scale score	0.993 [0.856-1.152]

*p<0.05

Table 10: Potentially Preventable Hospitalizations among Nursing Home Transitioners Compared with Nursing Home Stayers – Cox Proportional Hazards Model Results (N = 2,338)

Variable	Hazard Ratio [95% Confidence Interval]
Group	
Nursing Home Stayers (reference)	
Nursing Home Transitioners	1.290 [0.969-1.718]
Age	
65-70 (reference)	
71-75	1.227 [0.641-2.348]
76-80	1.420 [0.765-2.638]
81-85	1.256 [0.639-2.472]
86-90	0.775 [0.352-1.704]
91+	0.557 [0.227-1.367]
Gender	
Male (reference)	
Female	1.095 [0.665-1.804]
Race	
White (reference)	
Black	1.263 [0.676-2.361]
Hispanic	1.176 [0.649-2.130]
Other	3.522* [1.178-10.533]
Urban/Rural Residence	
Urban (reference)	
Rural	0.929 [0.606-1.423]
Reason for Medicaid Eligibility	
Poverty/Cash (reference)	
Medically Needy/Other	2.527* [1.417-4.507]
Diagnosis	
Anemia	0.802 [0.543-1.184]
Anxiety	0.943 [0.577-1.543]
Arthritis	0.819 [0.552-1.214]
Cancer	0.709 [0.387-1.301]
Chronic Kidney Disease	1.151[0.732-1.810]
Chronic Obstructive Pulmonary Disease	1.997* [1.318-3.028]
Dementia	1.020 [0.697-1.491]
Depression	1.108 [0.737-1.667]
Diabetes	1.062 [0.707-1.595]
Heart Failure	1.553* [1.015-2.375]
Hypertension	0.737 [0.424-1.281]
Ischemic Heart Disease	1.288 [0.883-1.877]
Stroke	1.171 [0.788-1.739]
Activities of Daily Living score	1.025 [0.997-1.053]
Cognitive Performance Scale score	0.896 [0.789-1.018]

*p<0.05

Figure 1: Graph of Estimated Cumulative Hazard for Potentially Preventable Hospitalizations among Nursing Home Stayers and Nursing Home Transitioners
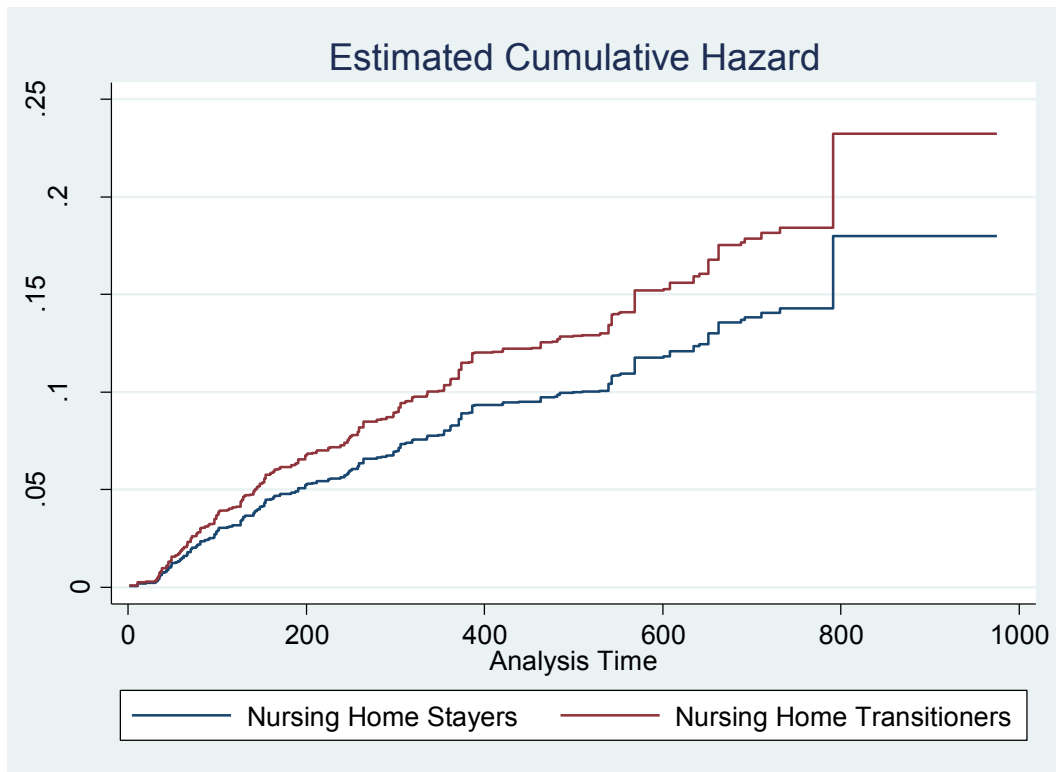
Chapter 6: Conclusions

The results from these set of analyses indicate that older adults receiving Medicaid home and community-based services (HCBS) frequently experience both potentially preventable and non-potentially preventable hospitalizations. Compared with older adults receiving Medicaid long-term care (LTC) in nursing homes, these individuals have an increased risk for preventable and non-preventable hospitalizations. This suggests that HCBS users' needs may not be adequately met to avoid hospitalization or these individuals may be seeking care in hospitals as opposed to outpatient settings more frequently than necessary. Current initiatives to reduce hospitalizations are being implemented in nursing homes, but there is no systematic investment for initiatives among the HCBS population despite their high risk for hospitalization. While providers and policymakers should focus on ensuring that both LTC needs and medical care needs are met for individuals in all LTC settings, specific attention should be focused on HCBS users because they not only have a high frequency of hospitalizations, they seem to have a higher risk for hospitalization than nursing home residents.

In order to reduce hospitalizations among HCBS users, it may be valuable to target subgroups of individuals who have particular risk for hospitalization. Individuals who had a recent hospitalization had an increased risk of experiencing another hospitalization compared with individuals who did not have a recent hospitalization, suggesting that improving transitions between settings and better post-hospital follow-up may reduce subsequent hospitalizations. Individuals who had a number of specific conditions, including COPD, heart failure, and ischemic heart disease, had an increased

risk for both potentially preventable and non-potentially preventable hospitalizations

compared with individuals who did not have those conditions. Concentrating on

individuals with these specific conditions may be a key way to target older HCBS users

in order to reduce hospitalizations. Providing more proactive outpatient care may meet

individuals' needs in a timelier manner at a lower level of care, which may reduce

hospitalizations among home and community-based LTC users. A large proportion of the

preventable hospitalizations among this population were due to acute conditions,

including pneumonia and urinary tract infections, which could likely be treated at a lower

level of care if individuals have access to timely and high quality outpatient services.

The increased risk of hospitalization for older Medicaid HCBS users compared

with nursing home residents suggests that nursing home residents experience fewer

events due to the medical care provided in the nursing home and/or there is different

treatment or management in the nursing home setting when an event does occur. This

treatment or management may be due to (1) the availability of resources and staff to treat

conditions within the nursing home rather than the hospital setting and (2) policies within

the nursing home, such as the use of advance directives which may reduce hospital

transfers for individuals who prefer less aggressive treatments. For the HCBS population,

it may be necessary to not only ensure that quality medical care is available so that

beneficiaries have access to outpatient services, but it may also be necessary to improve

communication between providers and caregivers so that all individuals are aware of

treatment plans. Formal and informal caregivers play a critical role in the overall care of

individuals with LTC needs, and making certain that these individuals know how to

respond or who to contact when a medical issue arises will impact the type of care that the LTC beneficiary receives. The results showing that individuals who transitioned from a nursing home to a home and community-based LTC setting had a higher risk for hospitalization compared with individuals who remained in the nursing home indicate that continuity of care and providers is likely an important part of keeping individuals out of hospitals. Following up with individuals once they have moved to another LTC setting to check whether they have access to providers and whether they have any unmet needs should confront many potential issues before problems evolve and become unmanageable in their setting.

Because most elderly Medicaid LTC beneficiaries are dual eligibles, there is likely cost-shifting between Medicaid and Medicare in their treatment. Both Medicaid and Medicare have an incentive to minimize costs, so for dual eligibles, these programs are likely shifting to services covered by the other program whenever possible. For HCBS users, this may mean that Medicaid has no incentive to provide more LTC or other services to try to meet the beneficiaries' needs when these individuals could use inpatient hospital services instead, thus shifting some costs of care from Medicaid to Medicare. New models of care and payment reforms are needed to incentivize providers to take total responsibility for their patients' care and to coordinate services across their continuum of needs. These reforms include models such as accountable care organizations (ACOs) and payment initiatives such as bundled payments. Restructuring the way care is delivered and paid for by Medicaid and Medicare may give providers the incentives needed to keep individuals out of hospitals in situations where it may not be necessary.

As demographics and demand for LTC change over the next several decades, focusing on meeting HCBS users' LTC and medical needs will become even more critical. More complex patients will likely remain in home and community settings, and we need better coordination between providers in order to keep individuals in these settings without multiple transitions between the home/community, hospital, and nursing home. Future investment by state Medicaid programs, as well as by Medicare, should focus on models that truly integrate LTC and medical care. Steps toward more integrated care are being taken, but it is important to understand how LTC fits within these models and how vulnerable Medicaid LTC beneficiaries fare over time. The incentives for providers for the larger Medicare or Medicaid population may not apply to older LTC beneficiaries, so future research should examine this population explicitly. Investment in better primary and LTC care and in integrated models should not only improve the health outcomes of beneficiaries but will likely save Medicaid and Medicare money by avoiding costly hospitalizations and subsequent post-hospital care.

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Appendices

Appendix 1: Aged/Physically Disabled Home and Community-based Service Waivers and Community State Plan Groups by State

State	Aged/Physically Disabled Home and Community-based Service Waivers	Community Long-term Care State Plans
Arkansas	• Alternatives for Adults with Physical Disabilities Waiver • ElderChoices Waiver	• Home health or personal care state plan beneficiaries
Florida	• Aging and Disabled Adults Waiver – Aging • Aging and Disabled Adults Waiver – Disabled • Channeling Waiver for Frail Elders • Nursing Home Diversion Waiver	• Home health state plan beneficiaries
Minnesota	• Community Alternative Care Waiver • Community Alternative for Disabled Individuals Waiver • Elderly Waiver	• Home health or personal care state plan beneficiaries
New Mexico	• Disabled and Elderly Waiver	• Home health or personal care state plan beneficiaries
Texas	• Community-Based Alternatives Waiver	• Home health or personal care state plan beneficiaries
Vermont	• Aged and Disabled Waiver • Enhanced Residential Care Waiver	• Home health state plan beneficiaries
Washington	• Community Options Program Entry System Aged and Disabled Waiver • Medically Needy In Home Waiver • Medically Needy Residential Waiver	• Home health or personal care state plan beneficiaries

Appendix 2: ICD-9 Codes for Ambulatory Care Sensitive Hospitalizations

Angina	411.1, 411.8, 413 • Excluding cases with surgical procedure 01-86.99
Asthma	493
Cellulitis	681, 682, 683, 686 • Excluding cases with surgical procedure 01-86.99 except incision of skin and subcutaneous tissue 86.0 where it is the only listed surgical procedure
Skin grafts with cellulitis	DRG 263 & 264 • Excluding admissions from a skilled nursing facility
Chronic Obstructive Pulmonary Disease	491, 492, 494, 496, 466.0 (466.0 only with secondary diagnosis of 491, 492, 494, 496)
Congestive Heart Failure	428, 402.01, 402.11, 402.91, 518.4 • Excluding cases with surgical procedures 36.01, 36.02, 36.05, 36.1, 37.5, 37.7
Dehydration	276.5
Diabetes Mellitus	250.1, 250.2, 250.3, 250.8, 250.9, 250.0
Gastroenteritis	558.9
Epileptic Convulsions	345, 780.3
Hypertension	401.0, 401.9, 402.00, 402.10, 402.90 • Excluding cases with procedures 36.01, 36.02, 36.05, 36.1, 37.5, 37.7
Hypoglycemia	251.2
Kidney/Urinary Tract Infection	590, 599.0, 599.9
Bacterial Pneumonia	481, 482.2, 482.3, 482.9, 483, 485, 486 • Excluding patients with secondary diagnosis of sickle cell 282.6
Severe Ear, Nose, and Throat Infections	382 (382 excluding cases with 20.01), 462, 463, 465, 472.1
Pulmonary Tuberculosis	011
Other Tuberculosis	012-018

Appendix 3: Procedure Codes for Outpatient Physician Visits

99058	Office Emergency Care
99201	Office/Outpatient Visit (for evaluation and management), New Patient, 10 minutes
99202	Office/Outpatient Visit (for evaluation and management), New Patient, 20 minutes
99203	Office/Outpatient Visit (for evaluation and management), New Patient, 30 minutes
99204	Office/Outpatient Visit (for evaluation and management), New Patient, 45 minutes
99205	Office/Outpatient Visit (for evaluation and management), New Patient, 60 minutes
99211	Office/Outpatient Visit (for evaluation and management), Established Patient, 5 minutes
99212	Office/Outpatient Visit (for evaluation and management), Established Patient, 10 minutes
99213	Office/Outpatient Visit (for evaluation and management), Established Patient, 15 minutes
99214	Office/Outpatient Visit (for evaluation and management), Established Patient, 25 minutes
99215	Office/Outpatient Visit (for evaluation and management), Established Patient, 40 minutes
99241	Office Consultation, New or Established Patient, 15 minutes
99242	Office Consultation, New or Established Patient, 30 minutes
99243	Office Consultation, New or Established Patient, 40 minutes
99244	Office Consultation, New or Established Patient, 60 minutes
99245	Office Consultation, New or Established Patient, 80 minutes
99324	Domiciliary/Rest Home Visit (for evaluation and management), New Patient, Low Severity
99325	Domiciliary/Rest Home Visit (for evaluation and management), New Patient, Moderate Severity
99326	Domiciliary/Rest Home Visit (for evaluation and management), New Patient, Mod/High Severity
99327	Domiciliary/Rest Home Visit (for evaluation and management), New Patient, High Severity
99328	Domiciliary/Rest Home Visit (for evaluation and management), New Patient, Significant New Problem
99334	Domiciliary/Rest Home Visit (for evaluation and management), Established Patient, Minor
99335	Domiciliary/Rest Home Visit (for evaluation and management), Established Patient, Low/Mod Severity
99336	Domiciliary/Rest Home Visit (for evaluation and management), Established Patient, Mod/High Severity
99337	Domiciliary/Rest Home Visit (for evaluation and management), Established Patient, Significant New Problem
99341	Home Visit (for evaluation and management), New Patient, Low Severity
99342	Home Visit (for evaluation and management), New Patient, Moderate Severity
99343	Home Visit (for evaluation and management), New Patient, Mod/High Severity
99344	Home Visit (for evaluation and management), New Patient, High Severity
99345	Home Visit (for evaluation and management), New Patient, Significant New Problem
99347	Home Visit (for evaluation and management), Established Patient, Minor
99348	Home Visit (for evaluation and management), Established Patient, Low/Mod Severity
99349	Home Visit (for evaluation and management), Established Patient, Mod/High Severity
99350	Home Visit (for evaluation and management), Established Patient, Significant New Problem
99354	Prolonged Service, Office or Outpatient Setting, Direct Contact 1st hour
99355	Prolonged Service, Office or Outpatient Setting, Direct Contact Additional 30 minutes
99387	Initial Preventative Medicine Visit (for evaluation and management), New Patient Age 65+
99397	Periodic Preventative Medicine Visit (for reevaluation and management), Established Patient Age 65+
99429	Unlisted Preventative Service
99499	Unlisted Evaluation and Management Service
G0344	Initial Preventive Physical Examination, New Medicare Beneficiary
G0402	Initial Preventative Physical Examination, First 12 Months Medicare Enrollment

Appendix 4: ICD-9 Codes for Diseases/Conditions

Anemia	280.xx, 281.xx, 282.xx, 283.xx, 284.xx, 285.xx
Anxiety	300.0x
Arthritis	714.xx, 715.xx, 716.xx
Cancer	140.x, 141.x, 142.x, 143.x, 144.x, 145.x, 146.x, 147.x, 148.x, 149.x, 150.x, 151.x, 152.x, 153.x, 154.x, 155.x, 156.x, 157.x, 158.x, 159.0, 160.x, 161.x, 162.x, 170.x, 171.x, 174.x, 175.x, 179, 180.x, 182.x, 185, 186.0, 186.9, 188.x, 189.0, 189.1, 191.x, 192.x, 195.0, 230.x, 231.x, 233.x, V10.xx
Chronic kidney disease	016.00, 016.01, 016.02, 016.03, 016.04, 016.05, 016.06, 095.4 , 189.0, 189.9, 223.0, 236.91, 249.40, 249.41, 250.40, 250.41, 250.42, 250.43, 271.4, 274.10, 283.11, 403.01, 403.11, 403.91, 404.02, 404.03, 404.12, 404.13, 404.92, 404.93, 440.1, 442.1, 572.4, 580.xx, 581.xx, 582.xx, 583.xx, 584.xx, 585, 585.1, 585.2, 585.3, 585.4, 585.5, 586, 587, 588.xx, 591, 753.12, 753.13, 753.14, 753.15, 753.16, 753.17, 753.19, 753.20, 753.21, 753.22, 753.23, 753.29, 794.4
Chronic Obstructive Pulmonary Disease	491.xx, 492.xx, 494.xx, 496.xx
Dementia	290.xx, 294.xx, 331.xx, 797
Depression	296.2x, 296.3x, 298, 300.4, 301.12, 309.0, 309.1, 311
Diabetes	249.xx, 250.xx, 357.2x, 362.0x, 366.41
Heart Failure	398.91, 402.01, 402.11, 402.91, 404.01, 404.11, 404.91, 404.03, 404.13, 404.93, 428.xx
Hypertension	401.0, 401.1, 401.9, 402.xx, 403.xx, 404.xx, 405.01, 405.09, 405.11, 405.19, 405.99, 437.2
Ischemic Heart Disease	410.xx, 411.0, 411.1, 411.8x, 412, 413.0, 413.1, 413.9, 414.x, 427.31, V45.81, V45.82
Stroke	430, 431, 432, 433, 434.xx, 435.xx, 436

Appendix 5: ICD-9 Codes for Potentially Preventable Hospitalizations (Defined from Centers for Medicare & Medicaid Services Report[17])

Congestive Heart Failure	398.91, 402.11, 402.91, 404.11, 404.13, 404.91, 404.93, 428.0, 428.1, 428.20, 428.21, 428.22, 428.23, 428.30, 428.31, 428.32, 428.33, 428.40, 428.41, 428.42, 428.43, 428.9, 518.4
Hypertension	401.9, 402.10, 402.90, 403.10, 403.90, 404.10, 404.90
Hypotension	458.0, 458.1, 458.21, 458.29, 458.8, 458.9
Poor glycemic control	250.02, 250.03, 250.10, 250.11, 250.12, 250.13, 250.20, 250.21, 250.22, 250.23, 250.30, 250.31, 250.32, 250.33, 251.0, 251.2, 790.29
Dehydration, volume depletion	276.5, 276.8
Hyponatremia	276.1
Acute renal failure	584.5, 584.6, 584.7, 584.8, 584.9, 588.81, 588.89, 588.9
Constipation/fecal impaction/obstipation	560.39, 564.00, 564.01, 564.09
Skin ulcers	707.00, 707.01, 707.02, 707.03, 707.04, 707.05, 707.06, 707.07, 707.09, 707.10, 707.11, 707.12, 707.13, 707.14, 707.15, 707.19, 707.8, 707.9
UTI	590.10, 590.11, 590.80, 590.81, 590.9, 595.0, 595.1, 595.2, 595.4, 595.89, 595.9, 597.0, 598.00, 598.01, 599.0, 601.0, 601.1, 601.2, 601.3, 601.4, 601.8, 601.9
Seizures	345.00, 345.01, 345.10, 345.11, 345.2, 345.3, 345.40, 345.41, 345.50, 345.51, 345.60, 345.61, 345.70, 345.71, 345.80, 345.81, 345.90, 345.91, 436, 780.31, 780.39
Asthma	493.00, 493.01, 493.02, 493.10, 493.11, 493.12, 493.20, 493.21, 493.22, 493.81, 493.82, 493.90, 493.91, 493.92
COPD, chronic bronchitis	466.0, 466.11, 466.19, 490, 491.0, 491.1, 491.20, 491.21, 491.8, 491.9, 492.0, 492.8, 494.0, 494.1, 496
Failure to thrive – weight loss	783.21, 783.22, 783.3, 783.7
Nutritional deficiencies	260, 261, 262, 263.0, 263.1, 263.2, 263.8, 263.9, 268.0, 268.1

For the Centers for Medicare & Medicaid Services (CMS) report, a technical expert panel identified this set of conditions that they believed may be more appropriate for analyzing preventable hospitalizations among the home and community-based long-term care population.

Appendix 6: Sample Description of Elderly Medicaid Home and Community-based Long-term Care Users for Analysis Using Centers for Medicare & Medicaid Services Report Definition of Potentially Preventable Hospitalizations
(N = 1,245,181)

Outcome	Percent
Potentially Preventable Hospitalization	3.57%
Non-Potentially Preventable Hospitalization	10.42%
Died	0.79%
None	85.22%

Appendix 7: Predictors of Potentially Preventable Hospitalizations among Elderly Medicaid Home and Community-based Long-term Care Users - Multinomial Logit Results from Analysis Using Centers for Medicare & Medicaid Services Report Definition

Variable	Potentially Preventable Hospitalization				Non-Potentially Preventable Hospitalization				Died			
	Coef	**SE**	**RRR**	**95% CI**	**Coef**	**SE**	**RRR**	**95% CI**	**Coef**	**SE**	**RRR**	**95% CI**
Physician Visit												
No (reference)												
Yes	0.028	0.017	1.028	0.995-1.062	0.127*	0.012	1.135	1.109-1.162	-0.639*	0.026	0.528	0.502-0.555
Age												
65-70 (reference)												
71-75	0.034	0.017	1.034	0.999-1.070	0.006	0.010	1.006	0.987-1.026	0.144*	0.038	1.155	1.071-1.245
76-80	0.045*	0.019	1.046	1.007-1.086	-0.003	0.013	0.997	0.971-1.024	0.259*	0.040	1.296	1.198-1.402
81-85	0.103*	0.025	1.109	1.055-1.165	0.017	0.013	1.017	0.991-1.044	0.405*	0.042	1.500	1.382-1.628
86-90	0.182*	0.031	1.200	1.129-1.275	0.071*	0.016	1.073	1.039-1.108	0.706*	0.050	2.025	1.836-2.233
91+	0.311*	0.033	1.365	1.279-1.456	0.192*	0.018	1.211	1.170-1.255	1.108*	0.052	3.028	2.736-3.350
Gender												
Male (reference)												
Female	0.022	0.016	1.022	0.991-1.055	-0.064*	0.008	0.938	0.923-0.953	-0.276*	0.024	0.759	0.724-0.796
Race												
White (reference)												
Black	-0.010	0.020	0.990	0.952-1.030	-0.121*	0.016	0.886	0.859-0.914	-0.174*	0.039	0.841	0.779-0.907
Hispanic	-0.044*	0.020	0.957	0.920-0.995	-0.013	0.011	0.987	0.966-1.008	-0.115*	0.052	0.892	0.805-0.987
Asian	-0.235*	0.080	0.791	0.676-0.925	-0.193*	0.058	0.825	0.736-0.924	-0.285*	0.094	0.752	0.625-0.905
Native American	0.019	0.065	1.020	0.898-1.158	0.142*	0.045	1.153	1.055-1.260	-0.016	0.107	0.984	0.797-1.214
Other	-0.098*	0.034	0.907	0.848-0.970	-0.076*	0.019	0.927	0.893-0.963	0.212*	0.060	1.236	1.099-1.390
Urban/Rural Residence												
Urban (reference)												
Rural	-0.057	0.031	0.944	0.889-1.003	0.005	0.016	1.005	0.975-1.037	-0.204*	0.043	0.815	0.749-0.887
Dual Eligible Status												
Medicaid-only (reference)												
Dual Eligible	0.056	0.046	1.057	0.967-1.156	0.110*	0.025	1.116	1.062-1.173	-0.269*	0.092	0.764	0.638-0.915
Reason for Medicaid Eligibility												

Appendix 7: Predictors of Potentially Preventable Hospitalizations among Elderly Medicaid Home and Community-based Long-term Care Users - Multinomial Logit Results from Analysis Using Centers for Medicare & Medicaid Services Report Definition

	Potentially Preventable Hospitalization				Non-Potentially Preventable Hospitalization				Died			
Poverty/Cash (reference)												
Medically Needy/Other	0.083*	0.016	1.087	1.054-1.121	0.107*	0.010	1.113	1.092-1.134	1.041*	0.090	2.833	2.374-3.381
Diagnosis												
Anemia	0.123*	0.013	1.131	1.103-1.160	0.228*	0.008	1.256	1.236-1.276	0.174*	0.024	1.190	1.134-1.248
Anxiety	0.169*	0.017	1.184	1.145-1.224	0.116*	0.010	1.123	1.102-1.145	-0.077	0.040	0.925	0.856-1.000
Arthritis	-0.079*	0.015	0.924	0.896-0.952	0.018	0.010	1.018	0.998-1.038	-0.416*	0.0233	0.660	0.630-0.690
Cancer	-0.003	0.016	0.997	0.967-1.029	0.182*	0.014	1.200	1.168-1.232	0.641*	0.027	1.898	1.798-2.003
Chronic Kidney Disease	0.381*	0.019	1.464	1.411-1.518	0.298*	0.013	1.347	1.314-1.380	0.534*	0.027	1.707	1.618-1.800
COPD	0.558*	0.013	1.747	1.701-1.793	0.234*	0.010	1.264	1.239-1.290	0.344*	0.030	1.411	1.330-1.497
Dementia	0.133*	0.019	1.142	1.099-1.186	0.136*	0.011	1.145	1.120-1.171	0.522*	0.024	1.686	1.608-1.768
Depression	0.055*	0.015	1.057	1.026-1.088	0.092*	0.009	1.096	1.077-1.115	-0.062*	0.030	0.940	0.887-0.997
Diabetes	0.225*	0.013	1.252	1.221-1.284	0.150*	0.008	1.162	1.144-1.181	-0.083*	0.023	0.920	0.880-0.962
Heart Failure	0.646*	0.016	1.908	1.849-1.969	0.231*	0.010	1.259	1.236-1.284	0.403*	0.025	1.496	1.425-1.571
Hypertension	-0.056*	0.016	0.946	0.916-0.976	-0.032*	0.010	0.968	0.949-0.987	-0.516*	0.030	0.597	0.563-0.633
Ischemic Heart Disease	0.261*	0.015	1.298	1.260-1.337	0.227*	0.009	1.255	1.232-1.278	0.047*	0.023	1.048	1.003-1.096
Stroke	0.098*	0.016	1.103	1.069-1.138	0.161*	0.009	1.175	1.154-1.196	0.145*	0.028	1.156	1.095-1.221
Previous Hospitalization												
No (reference)												
Yes	0.776*	0.013	2.173	2.117-2.230	0.642*	0.011	1.901	1.859-1.944	1.223*	0.031	3.397	3.199-3.607
Number of hospital beds per 1000 population 65+ in county (10s)	0.008	0.005	1.008	0.999-1.018	0.005	0.003	1.005	1.000-1.010	0.003	0.007	1.003	0.990-1.016
Per Capita County Income (1000s)	-0.004	0.003	0.996	0.989-1.002	-0.001	0.001	0.999	0.997-1.001	-0.002	0.004	0.998	0.991-1.005

Coef = Coefficient estimate; SE = Standard error; RRR = Relative risk ratio; 95% CI = 95% Confidence interval; COPD = Chronic Obstructive Pulmonary Disease

*p<0.05

Model also included categorical variables for quarter of observation and component economic area of residence

Appendix 8: Sample Description of Elderly Medicaid Home and Community-based Long-term Care Users for Analysis with Deaths Recoded
(N = 1,245,181)

Outcome	Percent
Potentially Preventable Hospitalization	4.07%
Non-Potentially Preventable Hospitalization	9.18%
Died	1.52%
None	85.22%

Appendix 9: Predictors of Potentially Preventable Hospitalizations among Elderly Medicaid Home and Community-based Long-term Care Users - Multinomial Logit Results from Analysis with Deaths Recoded

Variable	Potentially Preventable Hospitalization				Non-Potentially Preventable Hospitalization				Died			
	Coef	**SE**	**RRR**	**95% CI**	**Coef**	**SE**	**RRR**	**95% CI**	**Coef**	**SE**	**RRR**	**95% CI**
Physician Visit												
No (reference)												
Yes	0.049*	0.016	1.050	1.019-1.083	0.141*	0.012	1.151	1.124-1.178	-0.404*	0.020	0.667	0.642-0.694
Age												
65-70 (reference)												
71-75	0.028	0.016	1.028	0.998-1.060	0.001	0.010	1.001	0.981-1.021	0.125*	0.028	1.133	1.072-1.198
76-80	0.039	0.020	1.039	0.999-1.082	-0.014	0.014	0.986	0.960-1.012	0.225*	0.029	1.253	1.183-1.327
81-85	0.093*	0.026	1.098	1.044-0.154	-0.008	0.014	0.992	0.964-1.020	0.393*	0.031	1.482	1.395-1.575
86-90	0.169*	0.033	1.184	1.110-1.263	0.023	0.017	1.023	0.990-1.057	0.685*	0.037	1.984	1.846-2.133
91+	0.333*	0.030	1.396	1.316-1.479	0.097*	0.021	1.102	1.057-1.149	1.070*	0.034	2.915	2.730-3.113
Gender												
Male (reference)												
Female	-0.019	0.016	0.981	0.950-1.013	-0.037*	0.009	0.964	0.948-0.980	-0.264*	0.016	0.768	0.744-0.792
Race												
White (reference)												
Black	-0.109*	0.019	0.897	0.863-0.931	-0.083*	0.017	0.921	0.890-0.953	-0.132*	0.030	0.876	0.826-0.928
Hispanic	-0.020	0.015	0.980	0.951-1.010	-0.022	0.012	0.978	0.956-1.001	-0.043	0.046	0.958	0.876-1.048
Asian	-0.257*	0.085	0.773	0.654-0.914	-0.211	0.058	0.809	0.722-0.907	-0.029	0.077	0.972	0.835-1.131
Native American	0.116	0.061	1.123	0.996-1.265	0.111*	0.045	1.117	1.024-1.220	0.145	0.095	1.156	0.961-1.392
Other	-0.128*	0.029	0.880	0.831-0.932	-0.074*	0.020	0.929	0.894-0.965	0.208*	0.056	1.231	1.103-1.375
Urban/Rural Residence												
Urban (reference)												
Rural	-0.063*	0.032	0.939	0.883-1.000	0.020	0.017	1.020	0.987-1.053	-0.166*	0.033	0.847	0.795-0.903
Dual Eligible Status												
Medicaid-only (reference)												
Dual Eligible	0.042	0.048	1.043	0.949-1.147	0.123*	0.029	1.131	1.069-1.196	-0.182*	0.061	0.833	0.740-0.939
Reason for Medicaid Eligibility												

Appendix 9: Predictors of Potentially Preventable Hospitalizations among Elderly Medicaid Home and Community-based Long-term Care Users - Multinomial Logit Results from Analysis with Deaths Recoded

	Potentially Preventable Hospitalization				Non-Potentially Preventable Hospitalization				Died			
Poverty/Cash (reference)												
Medically Needy/Other	0.026	0.014	1.026	0.998-1.055	0.068*	0.012	1.070	1.046-1.095	1.069*	0.103	2.913	2.380-3.565
Diagnosis												
Anemia	0.095*	0.012	1.100	1.075-1.125	0.236*	0.009	1.267	1.245-1.288	0.263*	0.018	1.301	1.256-1.348
Anxiety	0.171*	0.016	1.187	1.150-1.224	0.119*	0.011	1.126	1.103-1.150	-0.028	0.028	0.972	0.921-1.026
Arthritis	-0.060*	0.015	0.941	0.914-0.970	0.036*	0.011	1.037	1.015-1.059	-0.352*	0.017	0.704	0.680-0.728
Cancer	0.022	0.015	1.023	0.992-1.054	0.163*	0.015	1.176	1.143-1.211	0.525*	0.023	1.691	1.617-1.768
Chronic Kidney Disease	0.265*	0.022	1.303	1.248-1.360	0.328*	0.012	1.388	1.355-1.422	0.548*	0.020	1.730	1.663-1.800
COPD	0.670*	0.014	1.954	1.900-2.008	0.149*	0.010	1.160	1.139-1.183	0.389*	0.020	1.476	1.420-1.534
Dementia	0.094*	0.017	1.099	1.063-1.136	0.131*	0.013	1.140	1.112-1.170	0.452*	0.018	1.572	1.517-1.629
Depression	0.072*	0.013	1.075	1.048-1.103	0.097*	0.010	1.102	1.081-1.123	-0.058*	0.022	0.944	0.905-0.985
Diabetes	0.269*	0.012	1.308	1.277-1.340	0.132*	0.009	1.141	1.120-1.161	0.004	0.016	1.004	0.974-1.036
Heart Failure	0.598*	0.015	1.819	1.765-1.874	0.207*	0.010	1.230	1.207-1.254	0.460*	0.020	1.584	1.522-1.648
Hypertension	-0.094*	0.014	0.910	0.885-0.936	-0.000	0.010	1.000	0.981-1.020	-0.402*	0.022	0.669	0.641-0.698
Ischemic Heart Disease	0.224*	0.015	1.251	1.216-1.288	0.246*	0.009	1.280	1.256-1.303	0.089*	0.017	1.093	1.057-1.131
Stroke	0.050*	0.017	1.051	1.016-1.087	0.184*	0.009	1.201	1.180-1.223	0.169*	0.019	1.184	1.141-1.229
Previous Hospitalization												
No (reference)												
Yes	0.723*	0.013	2.060	2.010-2.111	0.635*	0.012	1.887	1.843-1.933	1.095*	0.023	2.988	2.859-3.123
Number of hospital beds per 1000 population 65+ in county (10s)	0.004	0.005	1.004	0.995-1.013	0.007*	0.003	1.007	1.001-1.012	0.003	0.005	1.003	0.994-1.013
Per Capita County Income (1000s)	-0.006	0.003	0.995	0.988-1.001	-0.000	0.001	1.000	0.998-1.002	-0.004	0.002	0.996	0.992-1.000

Coef = Coefficient estimate; SE = Standard error; RRR = Relative risk ratio; 95% CI = 95% Confidence interval; COPD = Chronic Obstructive Pulmonary Disease

*p<0.05

Model also included categorical variables for quarter of observation and component economic area of residence

Appendix 10: Sample Description of Elderly Medicaid Home and Community-based Long-term Care Users for Analysis With One Observation Per Individual
(N = 197,337)

Outcome	Percent
Potentially Preventable Hospitalization	4.27%
Non-Potentially Preventable Hospitalization	9.82%
Died	1.07%
None	84.84%

Appendix 11: Predictors of Potentially Preventable Hospitalizations among Elderly Medicaid Home and Community-based Long-term Care Users – Multinomial Logit Results from Analysis with One Observation per Individual

Variable	Potentially Preventable Hospitalization				Non-Potentially Preventable Hospitalization				Died			
	Coef	**SE**	**RRR**	**95% CI**	**Coef**	**SE**	**RRR**	**95% CI**	**Coef**	**SE**	**RRR**	**95% CI**
Physician Visit												
No (reference)												
Yes	0.044	0.034	1.045	0.977-1.117	0.171*	0.029	1.187	1.222-1.255	-0.665*	0.055	0.514	0.462-0.573
Age												
65-70 (reference)												
71-75	-0.067*	0.033	0.935	0.877-0.998	-0.002	0.025	0.998	0.950-1.048	0.268*	0.080	1.308	1.117-1.530
76-80	-0.034	0.032	0.966	0.907-1.030	-0.019	0.027	0.981	0.931-1.034	0.217*	0.072	1.242	1.079-1.430
81-85	0.001	0.035	1.001	0.936-1.071	-0.016	0.027	0.985	0.933-1.039	0.518*	0.080	1.679	1.434-1.965
86-90	0.138*	0.045	1.148	1.050-1.255	0.027	0.034	1.027	0.961-1.098	0.683*	0.078	1.980	1.701-2.305
91+	0.306*	0.053	1.358	1.225-1.506	0.123*	0.040	1.130	1.046-1.222	1.041*	0.078	2.832	2.431-3.300
Gender												
Male (reference)												
Female	-0.020	0.027	0.980	0.929-1.033	-0.047*	0.019	0.954	0.919-0.991	-0.302*	0.053	0.740	0.667-0.820
Race												
White (reference)												
Black	-0.146*	0.037	0.864	0.805-0.929	-0.083*	0.030	0.921	0.868-0.977	-0.189*	0.068	0.828	0.725-0.945
Hispanic	-0.010	0.038	0.990	0.919-1.066	0.009	0.022	1.009	0.966-1.053	-0.236*	0.089	0.790	0.664-0.940
Asian	-0.118	0.092	0.889	0.743-1.064	-0.253*	0.093	0.776	0.647-0.932	-0.335	0.233	0.715	0.453-1.128
Native American	0.229*	0.112	1.258	1.009-1.567	0.066	0.082	1.068	0.909-1.255	-0.128	0.277	0.880	0.511-1.514
Other	-0.305*	0.063	0.737	0.651-0.835	-0.110*	0.042	0.896	0.824-0.974	0.127	0.110	1.135	0.915-1.407
Urban/Rural Residence												
Urban (reference)												
Rural	-0.054	0.048	0.947	0.863-1.040	-0.010	0.026	0.990	0.941-1.041	-0.355*	0.071	0.701	0.610-0.806
Dual Eligible Status												
Medicaid-only (reference)												
Dual Eligible	0.139	0.096	1.149	0.951-1.388	0.212*	0.064	1.237	1.092-1.401	-0.325*	0.155	0.723	0.533-0.980
Reason for Medicaid Eligibility												

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Appendix 11: Predictors of Potentially Preventable Hospitalizations among Elderly Medicaid Home and Community-based Long-term Care Users – Multinomial Logit Results from Analysis with One Observation per Individual

	Potentially Preventable Hospitalization				Non-Potentially Preventable Hospitalization				Died			
Poverty/Cash (reference)												
Medically Needy/Other	0.104*	0.028	1.110	1.051-1.172	0.123*	0.023	1.131	1.081-1.183	0.966*	0.090	2.627	2.203-3.131
Diagnosis												
Anemia	0.088*	0.025	1.092	1.041-1.147	0.255*	0.020	1.290	1.241-1.341	0.160*	0.058	1.173	1.047-1.315
Anxiety	0.176*	0.037	1.193	1.109-1.284	0.142*	0.033	1.153	1.081-1.229	-0.079	0.099	0.924	0.760-1.122
Arthritis	0.009	0.025	1.009	0.960-1.061	0.035	0.019	1.036	0.998-1.076	-0.388*	0.054	0.678	0.610-0.754
Cancer	0.029	0.036	1.030	0.959-1.106	0.201*	0.027	1.222	1.159-1.289	0.631*	0.063	1.880	1.661-2.128
Chronic Kidney Disease	0.286*	0.034	1.332	1.246-1.423	0.343*	0.023	1.410	1.347-1.475	0.501*	0.067	1.651	1.448-1.882
COPD	0.675*	0.027	1.965	1.865-2.070	0.120*	0.018	1.127	1.089-1.167	0.348*	0.052	1.417	1.279-1.569
Dementia	0.107*	0.033	1.113	1.044-1.186	0.158*	0.023	1.172	1.120-1.226	0.482*	0.059	1.619	1.443-1.816
Depression	0.061	0.032	1.062	0.999-1.130	0.110*	0.022	1.116	1.068-1.166	-0.093	0.079	0.911	0.780-1.064
Diabetes	0.267*	0.026	1.307	1.243-1.374	0.122*	0.020	1.130	1.086-1.176	-0.087	0.049	0.917	0.832-1.010
Heart Failure	0.637*	0.029	1.890	1.784-2.003	0.245*	0.020	1.278	1.229-1.329	0.431*	0.057	1.539	1.378-1.720
Hypertension	-0.102*	0.031	0.903	0.850-0.959	0.011	0.019	1.011	0.974-1.049	-0.476*	0.050	0.622	0.563-0.686
Ischemic Heart Disease	0.223*	0.028	1.250	1.183-1.320	0.247*	0.019	1.280	1.232-1.329	-0.023	0.055	0.977	0.877-1.088
Stroke	0.054	0.031	1.056	0.994-1.121	0.169*	0.023	1.184	1.131-1.240	0.172*	0.059	1.187	1.058-1.333
Previous Hospitalization												
No (reference)												
Yes	0.685*	0.027	1.984	1.883-2.090	0.605*	0.023	1.831	1.749-1.917	1.257*	0.049	3.514	3.194-3.866
Number of hospital beds per 1000 population 65+ in county (10s)	0.009	0.007	1.009	0.995-1.024	0.001	0.005	1.001	0.991-1.012	-0.011	0.013	0.989	0.965-1.013
Per Capita County Income (1000s)	-0.002	0.004	0.998	0.990-1.005	0.000	0.002	1.000	0.996-1.004	-0.009*	0.004	0.991	0.983-0.999

Coef = Coefficient estimate; SE = Standard error; RRR = Relative risk ratio; 95% CI = 95% Confidence interval; COPD = Chronic Obstructive Pulmonary Disease

*p<0.05

Model also included categorical variables for quarter of observation and component economic area of residence

Appendix 12: Description of Instruments for Instrumental Variable Model Comparing Elderly Medicaid Home and Community-based Long-term Care Users with Nursing Home Residents

The U.S. Census Bureau produces an annual series of data called the County Business

Patterns, which provides economic data by industry for small geographic areas (see

http://www.census.gov/econ/cbp/). The Census Bureau uses information on employer

establishments from the Business Register to produce the County Business Patterns. The

Business Register is a multi-source database that contains a record for each known

establishment in the U.S. (including Puerto Rico and Island Areas) with paid employees.

For the purposes of the County Business Patterns, the Census categorizes establishments

(businesses) based on their physical location, which is defined as a fixed physical

location or permanent structure where some business activity takes place.

The following North American Industry Classification System (NAICS) codes were used

to construct the instruments for this analysis:

Code and Name	Description
621610 Home Health Care Services	This industry comprises establishments primarily engaged in providing skilled nursing services in the home, along with a range of the following: personal care services, homemaker and companion services; physical therapy; medical social services; medications; medical equipment and supplies; counseling; 24-hour home care; occupation and vocational therapy; dietary and nutritional services; speech therapy; audiology; and high-tech care, such as intravenous therapy.
623312 Homes for the Elderly	This industry comprises establishments primarily engaged in providing residential and personal care services (i.e., without on-site nursing care facilities) for (1) the elderly or other persons who are unable to fully care for themselves and/or (2) the elderly or other persons who do not desire to live independently. The care typically includes room, board, supervision, and assistance in daily living, such as housekeeping services.
624120 Services for the Elderly and Persons with Disabilities	This industry comprises establishments primarily engaged in providing nonresidential social assistance services to improve the quality of life for the elderly, persons diagnosed with mental retardation, or persons with disabilities. These establishments

	provide for the welfare of these individuals in such areas as day care, nonmedical home care or homemaker services, social activities, group support, and companionship.
623110 Nursing Care Facilities	This industry comprises establishments primarily engaged in providing inpatient nursing and rehabilitative services. The care is generally provided for an extended period of time to individuals requiring nursing care. These establishments have a permanent core staff of registered or licensed practical nurses who, along with other staff, provide nursing and continuous personal care services.

To maintain confidentiality, some reported numbers in the County Business Patterns are provided as ranges. In order to be consistent across cells where ranges were reported as opposed to specific numbers were reported, all numbers were recoded to the mean of the range in which they fell. The ranges were: 0-19; 20-99; 100-249; 250-499; 500-999; 1000-2499; 2500-4999; 5000-9999; 10000-24999; 25000-49999.

Appendix 13: Sample Description of Elderly Medicaid Nursing Home and Home and Community-based Long-term Care Users for Analysis Using Centers for Medicare & Medicaid Services Report Definition of Potentially Preventable Hospitalizations

	Percent	
Variable	**Nursing Home** **(N = 1,089,573)**	**HCBS** **(N = 1,245,181)**
Outcome		
Potentially Preventable Hospitalization	2.94%	3.57%
Non-Potentially Preventable Hospitalization	9.46%	10.42%
Died	3.34%	0.79%
None	84.25%	85.22%

Each outcome category significantly different at p<0.05

Appendix 14: Potentially Preventable Hospitalizations among Elderly Medicaid Home and Community-based Users Compared with Nursing Home Residents – Second Stage Multinomial Logit Results from Instrumental Variable Model from Analysis Using Centers for Medicare & Medicaid Services Report Definition

	Potentially Preventable Hospitalization				Non-Potentially Preventable Hospitalization				Died			
Variable	**Coef**	**SE**	**RRR**	**95% CI**	**Coef**	**SE**	**RRR**	**95% CI**	**Coef**	**SE**	**RRR**	**95% CI**
Long-term Care Group												
Nursing Home (reference)												
HCBS	0.458*	0.049	1.580	1.434-1.741	0.308*	0.028	1.361	1.288-1.437	-0.797*	0.038	0.451	0.418-0.486
Residual from first stage	-0.032	0.016	0.969	0.938-1.000	-0.021*	0.010	0.979	0.961-0.998	-0.008	0.015	0.992	0.964-1.021
Age												
65-70 (reference)												
71-75	0.026	0.015	1.026	0.997-1.057	0.013	0.009	1.013	0.995-1.032	0.204*	0.024	1.227	1.170-1.286
76-80	0.050*	0.018	1.052	1.016-1.089	0.000	0.011	1.000	0.979-1.021	0.417*	0.022	1.517	1.454-1.583
81-85	0.092*	0.023	1.097	1.048-1.148	0.008	0.012	1.008	0.985-1.032	0.611*	0.023	1.843	1.762-1.928
86-90	0.124*	0.028	1.132	1.070-1.197	0.032*	0.014	1.032	1.033-1.062	0.844*	0.025	2.326	2.216-2.441
91+	0.167*	0.034	1.182	1.105-1.264	0.034	0.019	1.034	0.997-1.074	1.189*	0.025	3.285	3.125-3.453
Gender												
Male (reference)												
Female	0.012	0.012	1.012	0.989-1.036	-0.145*	0.007	0.865	0.854-0.876	-0.242*	0.013	0.785	0.766-0.805
Race												
White (reference)												
Black	0.043*	0.019	1.043	1.006-1.082	-0.052*	0.013	0.949	0.926-0.974	-0.299*	0.024	0.741	0.707-0.777
Hispanic	-0.014	0.016	0.987	0.955-1.019	0.015	0.011	1.015	0.994-1.038	-0.266*	0.033	0.766	0.719-0.817
Asian	-0.172*	0.068	0.842	0.737-0.962	-0.093	0.052	0.911	0.823-1.009	-0.529*	0.072	0.589	0.512-0.679
Native American	0.097	0.055	1.102	0.990-1.226	0.204*	0.032	1.226	1.152-1.306	-0.071	0.090	0.932	0.781-1.111
Other	-0.038	0.025	0.963	0.917-1.011	-0.042*	0.017	0.959	0.928-0.991	0.052	0.035	1.053	0.984-1.127
Urban/Rural Residence												
Urban (reference)												
Rural	-0.054	0.030	0.947	0.894-1.003	0.043*	0.017	1.044	1.009-1.079	-0.092*	0.028	0.912	0.863-0.964
Dual Eligible Status												
Medicaid-only (reference)												
Dual Eligible	-0.008	0.035	0.992	0.926-1.064	0.055*	0.023	1.056	1.009-1.105	-0.318*	0.055	0.728	0.653-0.811

Appendix 14: Potentially Preventable Hospitalizations among Elderly Medicaid Home and Community-based Users Compared with Nursing Home Residents – Second Stage Multinomial Logit Results from Instrumental Variable Model from Analysis Using Centers for Medicare & Medicaid Services Report Definition

	Potentially Preventable Hospitalization				Non-Potentially Preventable Hospitalization				Died			
Reason for Medicaid Eligibility												
Poverty/Cash (reference)												
Medically Needy/Other	0.091*	0.020	1.095	1.054-1.138	0.097*	0.013	1.102	1.075-1.130	0.588*	0.072	1.801	1.563-2.076
Diagnosis												
Anemia	0.116*	0.013	1.123	1.094-1.152	0.194*	0.009	1.214	1.193-1.235	0.085*	0.013	1.089	1.061-1.117
Anxiety	0.120*	0.013	1.127	1.099-1.156	0.090*	0.007	1.094	1.080-1.110	-0.077*	0.016	0.926	0.897-0.955
Arthritis	-0.070*	0.013	0.933	0.909-0.957	0.002	0.009	1.002	0.984-1.020	-0.262*	0.013	0.769	0.751-0.789
Cancer	0.000	0.012	1.000	0.977-1.024	0.150*	0.011	1.162	1.139-1.187	0.307*	0.018	1.360	1.314-1.408
Chronic Kidney Disease	0.383*	0.014	1.466	1.426-1.508	0.282*	0.009	1.326	1.302-1.350	0.435*	0.015	1.545	1.500-1.592
COPD	0.454*	0.011	1.574	1.540-1.610	0.242*	0.008	1.274	1.256-1.293	0.182*	0.014	1.200	1.169-1.233
Dementia	0.067*	0.027	1.070	1.014-1.128	0.070*	0.018	1.073	1.036-1.111	0.265*	0.018	1.303	1.257-1.350
Depression	0.045*	0.014	1.046	1.018-1.075	0.062*	0.008	1.064	1.047-1.081	-0.091*	0.013	0.913	0.890-0.938
Diabetes	0.234*	0.010	1.264	1.238-1.290	0.155*	0.007	1.168	1.152-1.184	-0.054*	0.011	0.947	0.927-0.967
Heart Failure	0.552*	0.017	1.737	1.678-1.797	0.211*	0.009	1.235	1.214-1.256	0.246*	0.014	1.279	1.246-1.313
Hypertension	0.0202	0.012	1.020	0.996-1.045	0.023*	0.008	1.024	1.007-1.040	-0.307*	0.015	0.736	0.715-0.757
Ischemic Heart Disease	0.242*	0.011	1.273	1.246-1.301	0.186*	0.007	1.205	1.189-1.221	0.034*	0.011	1.035	1.013-1.058
Stroke	0.114*	0.014	1.120	1.090-1.152	0.141*	0.011	1.151	1.127-1.176	0.096*	0.013	1.101	1.073-1.129
Previous Hospitalization												
No (reference)												
Yes	0.756*	0.010	2.129	2.086-2.173	0.656*	0.007	1.927	1.901-1.953	1.017*	0.018	2.764	2.668-2.863
Number of hospital beds per 1000 population 65+ in county (10s)	0.013*	0.005	1.013	1.004-1.022	0.007*	0.003	1.007	1.002-1.013	-0.008	0.005	0.992	0.983-1.001

Appendix 14: Potentially Preventable Hospitalizations among Elderly Medicaid Home and Community-based Users Compared with Nursing Home Residents – Second Stage Multinomial Logit Results from Instrumental Variable Model from Analysis Using Centers for Medicare & Medicaid Services Report Definition

	Potentially Preventable Hospitalization				Non-Potentially Preventable Hospitalization				Died			
Per Capita County Income (1000s)	-0.008*	0.002	0.992	0.987-0.997	-0.002	0.001	0.998	0.996-1.000	-0.002	0.003	0.998	0.993-1.003

Coef = Coefficient estimate; SE = Standard error; RRR = Relative risk ratio; 95% CI = 95% Confidence interval; COPD = Chronic Obstructive Pulmonary Disease

*p<0.05

Model also included categorical variables for quarter of observation and component economic area of residence

Appendix 15: Potentially Preventable Hospitalizations among Elderly Medicaid Home and Community-based Users Compared with Nursing Home Residents – Multinomial Logit Results for Propensity Score Analysis Using Inverse Probability Weighting

Variable	Potentially Preventable Hospitalization				Non-Potentially Preventable Hospitalization				Died			
	Coef	SE	RRR	95% CI	Coef	SE	RRR	95% CI	Coef	SE	RRR	95% CI
Long-term Care Group												
Nursing Home (reference)												
HCBS	0.253*	0.028	1.288	1.219-1.362	0.234*	0.022	1.264	1.211-1.318	-0.740*	0.035	0.477	0.445-0.512
Age												
65-70 (reference)												
71-75	0.019	0.029	1.019	0.962-1.079	0.006	0.020	1.006	0.967-1.046	0.233*	0.045	1.262	1.155-1.379
76-80	0.020	0.032	1.020	0.958-1.086	-0.040*	0.019	0.961	0.926-0.997	0.479*	0.043	1.614	1.484-1.757
81-85	0.087*	0.033	1.091	1.023-1.163	-0.039	0.021	0.962	0.924-1.002	0.642*	0.041	1.900	1.753-2.059
86-90	0.116*	0.035	1.123	1.049-1.202	-0.019	0.025	0.981	0.934-1.031	0.873*	0.043	2.394	2.201-2.605
91+	0.162*	0.035	1.175	1.097-1.259	-0.043	0.028	0.958	0.907-1.011	1.250*	0.045	3.492	3.195-3.816
Gender												
Male (reference)												
Female	-0.006	0.019	0.994	0.957-1.033	-0.084*	0.015	0.919	0.893-0.946	-0.186*	0.030	0.830	0.782-0.881
Race												
White (reference)												
Black	-0.071*	0.027	0.931	0.884-0.981	0.008	0.018	1.008	0.974-1.044	-0.240*	0.045	0.787	0.720-0.859
Hispanic	0.014	0.037	1.014	0.944-1.090	0.055*	0.024	1.056	1.008-1.107	-0.232*	0.048	0.793	0.722-0.870
Asian	-0.187*	0.055	0.830	0.744-0.925	-0.020	0.093	0.980	0.817-1.176	-0.329*	0.147	0.720	0.539-0.961
Native American	0.248*	0.082	1.281	1.091-1.504	0.153*	0.043	1.166	1.070-1.269	-0.177	0.123	0.837	0.658-1.067
Other	0.008	0.072	1.008	0.875-1.162	-0.039	0.038	0.962	0.894-1.035	0.035	0.048	1.035	0.942-1.138
Urban/Rural Residence												
Urban (reference)												
Rural	-0.070	0.036	0.932	0.869-1.000	0.045*	0.019	1.046	1.008-1.085	-0.142*	0.038	0.867	0.805-0.935
Dual Eligible Status												
Medicaid-only (reference)												
Dual Eligible	-0.024	0.055	0.976	0.876-1.088	0.079*	0.033	1.082	1.015-1.153	-0.356*	0.080	0.700	0.599-0.818
Reason for Medicaid Eligibility												

Appendix 15: Potentially Preventable Hospitalizations among Elderly Medicaid Home and Community-based Users Compared with Nursing Home Residents – Multinomial Logit Results for Propensity Score Analysis Using Inverse Probability Weighting

	Potentially Preventable Hospitalization				Non-Potentially Preventable Hospitalization				Died			
Poverty/Cash (reference)												
Medically Needy/Other	0.075*	0.019	1.078	1.039-1.119	0.061*	0.014	1.063	1.035-1.092	0.658*	0.074	1.930	1.669-2.233
Diagnosis												
Anemia	0.076*	0.021	1.079	1.035-1.125	0.185*	0.013	1.203	1.173-1.233	0.086*	0.025	1.090	1.038-1.145
Anxiety	0.042	0.027	1.043	0.989-1.100	0.056*	0.022	1.058	1.014-1.105	-0.053	0.050	0.948	0.859-1.046
Arthritis	-0.032	0.023	0.968	0.926-1.013	0.003	0.017	1.003	0.970-1.038	-0.294*	0.022	0.745	0.714-0.778
Cancer	0.078*	0.026	1.081	1.028-1.137	0.153*	0.026	1.166	1.107-1.227	0.328*	0.028	1.388	1.313-1.468
Chronic Kidney Disease	0.255*	0.026	1.290	1.227-1.357	0.317*	0.015	1.373	1.332-1.415	0.455*	0.035	1.577	1.471-1.690
COPD	0.566*	0.029	1.760	1.664-1.862	0.171*	0.016	1.187	1.151-1.224	0.222*	0.028	1.248	1.182-1.317
Dementia	0.006	0.016	1.006	0.974-1.039	0.066*	0.012	1.068	1.043-1.093	0.293*	0.017	1.341	1.297-1.385
Depression	0.041*	0.018	1.042	1.007-1.079	0.040*	0.012	1.041	1.018-1.065	-0.151*	0.028	0.860	0.814-0.909
Diabetes	0.225*	0.021	1.253	1.203-1.305	0.145*	0.014	1.156	1.124-1.190	-0.043	0.023	0.958	0.915-1.003
Heart Failure	0.468*	0.021	1.597	1.532-1.665	0.179*	0.012	1.196	1.167-1.226	0.229*	0.027	1.257	1.193-1.325
Hypertension	0.024	0.027	1.024	0.971-1.080	0.039*	0.017	1.039	1.005-1.075	-0.389*	0.032	0.678	0.637-0.721
Ischemic Heart Disease	0.195*	0.020	1.216	1.169-1.264	0.200*	0.014	1.222	1.188-1.256	0.019	0.026	1.020	0.970-1.072
Stroke	0.067*	0.021	1.070	1.026-1.115	0.158*	0.013	1.171	1.141-1.202	0.132*	0.024	1.141	1.088-1.197
Previous Hospitalization												
No (reference)												
Yes	0.725*	0.015	2.065	2.004-2.129	0.675*	0.015	1.964	1.908-2.022	1.070*	0.029	2.917	2.753-3.090
Number of hospital beds per 1000 population 65+ in county (10s)	0.007	0.006	1.007	0.996-1.018	0.009*	0.003	1.009	1.003-1.015	-0.009	0.005	0.991	0.981-1.000
Per Capita County Income (1000s)	-0.007*	0.003	0.993	0.987-0.998	-0.000	0.001	1.000	0.998-1.002	-0.007*	0.003	0.993	0.987-0.999

Coef = Coefficient estimate; SE = Standard error; RRR = Relative risk ratio; 95% CI = 95% Confidence interval; COPD = Chronic Obstructive Pulmonary Disease

*p<0.05

Model also included categorical variables for quarter of observation and component economic area of residence

Appendix 16: Sample Description of Elderly Medicaid Nursing Home and Home and Community-based Long-term Care Users for Analysis with Deaths Recoded

	Percent	
Variable	**Nursing Home** (N = 1,089,573)	**HCBS** (N = 1,245,181)
Outcome		
Potentially Preventable Hospitalization	3.25%	4.07%
Non-Potentially Preventable Hospitalization	7.43%	9.18%
Died	5.07%	1.52%
None	84.25%	85.22%

Each outcome category significantly different at p<0.05

Appendix 17: Potentially Preventable Hospitalizations among Elderly Medicaid Home and Community-based Users Compared with Nursing Home Residents – Second Stage Multinomial Logit Results from Instrumental Variable Model from Analysis with Deaths Recoded

	Potentially Preventable Hospitalization				Non-Potentially Preventable Hospitalization				Died			
Variable	**Coef**	**SE**	**RRR**	**95% CI**	**Coef**	**SE**	**RRR**	**95% CI**	**Coef**	**SE**	**RRR**	**95% CI**
Long-term Care Group												
Nursing Home (reference)												
HCBS	0.430*	0.042	1.537	1.417-1.668	0.412*	0.032	1.510	1.418-1.608	-0.606*	0.036	0.545	0.509-0.585
Residual from first stage	-0.033*	0.014	0.968	0.941-0.995	-0.032*	0.011	0.969	0.949-0.990	0.009	0.012	1.009	0.986-1.032
Age												
65-70 (reference)												
71-75	0.027	0.013	1.027	1.000-1.054	0.003	0.010	1.003	0.984-1.023	0.170*	0.019	1.185	1.142-1.230
76-80	0.046*	0.017	1.047	1.012-1.083	-0.023	0.012	0.977	0.955-1.001	0.345*	0.017	1.412	1.367-1.459
81-85	0.075*	0.023	1.078	1.031-1.126	-0.033*	0.014	0.968	0.942-0.995	0.532*	0.018	1.702	1.642-1.763
86-90	0.110*	0.029	1.116	1.054-1.182	-0.037*	0.017	0.964	0.933-0.995	0.742*	0.120	2.099	2.019-2.183
91+	0.162*	0.034	1.175	1.099-1.257	-0.089*	0.023	0.915	0.875-0.956	1.044*	0.023	2.839	2.716-2.968
Gender												
Male (reference)												
Female	-0.035*	0.011	0966	0.945-0.987	-0.109*	0.007	0.896	0.885-0.908	-0.275*	0.009	0.760	0.747-0.773
Race												
White (reference)												
Black	-0.073*	0.020	0.930	0.893-0.967	-0.002	0.015	0.998	0.970-1.027	-0.194*	0.022	0.824	0.790-0.859
Hispanic	-0.013	0.015	0.987	0.959-1.016	0.017	0.013	1.017	0.991-1.043	-0.139*	0.031	0.870	0.819-0.924
Asian	-0.172*	0.074	0.842	0.728-0.974	-0.110*	0.050	0.896	0.812-0.989	-0.293*	0.071	0.746	0.649-0.858
Native American	0.184*	0.063	1.202	1.062-1.361	0.172*	0.032	1.188	1.117-1.264	0.059	0.072	1.061	0.921-1.222
Other	-0.077*	0.024	0.926	0.884-0.970	-0.031	0.016	0.969	0.939-1.001	0.057	0.029	1.059	1.000-1.122
Urban/Rural Residence												
Urban (reference)												
Rural	-0.058	0.032	0.943	0.887-1.004	0.051*	0.017	1.052	1.017-1.088	-0.047*	0.023	0.954	0.912-0.998
Dual Eligible Status												
Medicaid-only (reference)												
Dual Eligible	-0.030	0.036	0.970	0.904-1.040	0.061*	0.026	1.063	1.010-1.118	-0.203*	0.040	0.816	0.755-0.883

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Appendix 17: Potentially Preventable Hospitalizations among Elderly Medicaid Home and Community-based Users Compared with Nursing Home Residents – Second Stage Multinomial Logit Results from Instrumental Variable Model from Analysis with Deaths Recoded

	Potentially Preventable Hospitalization				Non-Potentially Preventable Hospitalization				Died			
Reason for Medicaid Eligibility												
Poverty/Cash (reference)												
Medically Needy/Other	0.049*	0.015	1.051	1.020-1.082	0.062*	0.014	1.064	1.035-1.094	0.603*	0.083	1.828	1.553-2.152
Diagnosis												
Anemia	0.095*	0.012	1.099	1.075-1.125	0.204*	0.010	1.227	1.203-1.250	0.137*	0.012	1.147	1.121-1.174
Anxiety	0.136*	0.012	1.146	1.119-1.173	0.097*	0.008	1.102	1.085-1.119	-0.057*	0.012	0.944	0.923-0.966
Arthritis	-0.050*	0.013	0.951	0.927-0.976	0.018	0.010	1.019	0.999-1.038	-0.228*	0.013	0.796	0.776-0.816
Cancer	0.029*	0.013	1.029	1.004-1.055	0.131*	0.012	1.140	1.114-1.167	0.285*	0.016	1.330	1.289-1.373
Chronic Kidney Disease	0.256*	0.017	1.292	1.249-1.336	0.314*	0.009	1.368	1.343-1.394	0.444*	0.012	1.559	1.522-1.598
COPD	0.579*	0.012	1.785	1.743-1.827	0.157*	0.008	1.170	1.152-1.189	0.252*	0.011	1.287	1.260-1.315
Dementia	0.034	0.024	1.035	0.988-1.084	0.071*	0.020	1.074	1.031-1.118	0.232*	0.017	1.262	1.221-1.304
Depression	0.060*	0.012	1.062	1.039-1.087	0.074*	0.009	1.076	1.058-1.096	-0.075*	0.011	0.928	0.909-0.948
Diabetes	0.255*	0.010	1.290	1.265-1.315	0.144*	0.008	1.155	1.138-1.173	0.021*	0.008	1.021	1.005-1.038
Heart Failure	0.511*	0.017	1.666	1.613-1.721	0.192*	0.009	1.211	1.190-1.232	0.294*	0.013	1.341	1.308-1.375
Hypertension	-0.014	0.012	0.986	0.964-1.009	0.051*	0.009	1.052	1.034-1.070	-0.236*	0.012	0.790	0.771-0.809
Ischemic Heart Disease	0.200*	0.010	1.222	1.198-1.246	0.202*	0.007	1.224	1.207-1.241	0.087*	0.010	1.091	1.071-1.111
Stroke	0.082*	0.014	1.085	1.056-1.115	0.157*	0.012	1.170	1.143-1.198	0.119*	0.012	1.126	1.101-1.152
Previous Hospitalization												
No (reference)												
Yes	0.701*	0.010	2.015	1.976-2.055	0.648*	0.007	1.912	1.887-1.938	0.962*	0.013	2.618	2.550-2.687
Number of hospital beds per 1000 population 65+ in county (10s)	0.008	0.005	1.008	0.999-1.017	0.010*	0.003	1.010	1.004-1.016	-0.004	0.004	0.996	0.987-1.004

Appendix 17: Potentially Preventable Hospitalizations among Elderly Medicaid Home and Community-based Users Compared with Nursing Home Residents – Second Stage Multinomial Logit Results from Instrumental Variable Model from Analysis with Deaths Recoded

	Potentially Preventable Hospitalization				Non-Potentially Preventable Hospitalization				Died			
Per Capita County Income (1000s)	-0.009*	0.003	0.992	0.987-0.996	-0.000	0.001	1.000	0.997-1.002	-0.004	0.002	0.996	0.992-1.000

Coef = Coefficient estimate; SE = Standard error; RRR = Relative risk ratio; 95% CI = 95% Confidence interval; COPD = Chronic Obstructive Pulmonary Disease

*p<0.05

Model also included categorical variables for quarter of observation and component economic area of residence

Appendix 18: Sample Description of Elderly Medicaid Nursing Home and Home and Community-based Long-term Care Users for Analysis with One Observation per Individual

Variable	Percent	
	Nursing Home (N = 192,762)	HCBS (N = 197,337)
Outcome		
Potentially Preventable Hospitalization	3.97%	4.27%
Non-Potentially Preventable Hospitalization	9.22%	9.82%
Died	4.21%	1.07%
None	82.60%	84.84%

Each outcome category significantly different at p<0.05

Appendix 19: Potentially Preventable Hospitalizations among Elderly Medicaid Home and Community-based Users Compared with Nursing Home Residents – First Stage Logit Results for Instrumental Variable Model from Analysis with One Observation per Individual

Variable	Coefficient	Standard Error
Instruments		
Home Health Care Services Employees per 1000 population 65+ in county	0.0006*	0.0001
Homes for the Elderly Employees per 1000 population 65+ in county	0.0007	0.0027
Services for the Elderly and Persons with Disabilities Employees per 1000 population 65+ in county	0.0025*	0.0007
Nursing Home Employees per 1000 population 65+ in county	-0.0048*	0.0007
Age		
65-70 (reference)		
71-75	-0.1847*	0.0231
76-80	-0.4316*	0.0285
81-85	-0.6734*	0.0345
86-90	-0.9226*	0.0360
91+	-1.2707*	0.0416
Gender		
Male (reference)		
Female	0.3796*	0.0159
Race		
White (reference)		
Black	0.8073*	0.0999
Hispanic	0.8761*	0.0352
Asian	0.6372*	0.1307
Native American	0.4487*	0.1459
Other	0.6094*	0.1040
Urban/Rural Residence		
Urban (reference)		
Rural	-0.0050	0.0442
Dual Eligible Status		
Medicaid-only (reference)		

Appendix 19: Potentially Preventable Hospitalizations among Elderly Medicaid Home and Community-based Users Compared with Nursing Home Residents – First Stage Logit Results for Instrumental Variable Model from Analysis with One Observation per Individual

Variable	Coefficient	Standard Error
Dual Eligible	0.6241*	0.0991
Reason for Medicaid Eligibility		
Poverty/Cash (reference)		
Medically Needy/Other	-1.5920*	0.0705
Diagnosis		
Anemia	-0.6358*	0.0318
Anxiety	0.0134	0.0277
Arthritis	0.4175*	0.0239
Cancer	0.3411*	0.0184
Chronic Kidney Disease	0.0931*	0.0259
COPD	0.3524*	0.0393
Dementia	-1.7606*	0.0344
Depression	-0.9288*	0.0327
Diabetes	-0.0428*	0.0153
Heart Failure	-0.5222*	0.0400
Hypertension	0.2942*	0.0282
Ischemic Heart Disease	0.2868*	0.0159
Stroke	-0.6631*	0.0274
Previous Hospitalization		
No (reference)		
Yes	0.4665*	0.0224
Number of hospital beds per 1000 population 65+ in county (10s)	0.0072	0.0064
Per Capita County Income (1000s)	-0.0346*	0.0043

COPD = Chronic Obstructive Pulmonary Disease
*p<0.05
Model also included categorical variables for quarter of observation and component economic area of residence

Appendix 20: Potentially Preventable Hospitalizations among Elderly Medicaid Home and Community-based Users Compared with Nursing Home Residents – Second Stage Multinomial Logit Results for Instrumental Variable Model from Analysis with One Observation per Individual

Variable	Potentially Preventable Hospitalization				Non-Potentially Preventable Hospitalization				Died			
	Coef	**SE**	**RRR**	**95% CI**	**Coef**	**SE**	**RRR**	**95% CI**	**Coef**	**SE**	**RRR**	**95% CI**
Long-term Care Group												
Nursing Home (reference)												
HCBS	0.242*	0.064	1.273	1.124-1.443	0.256*	0.041	1.292	1.192-1.400	-0.805*	0.054	0.447	0.402-0.497
Residual from first stage	-0.017	0.023	0.983	0.939-1.028	-0.021	0.014	0.979	0.953-1.006	-0.007	0.019	0.993	0.957-1.029
Age												
65-70 (reference)												
71-75	-0.059*	0.027	0.943	0.894-0.994	-0.017	0.020	0.983	0.946-1.023	0.306*	0.054	1.359	1.222-1.510
76-80	-0.008	0.026	0.993	0.943-1.045	-0.030	0.020	0.970	0.933-1.009	0.458*	0.045	1.581	1.447-1.727
81-85	0.026	0.029	1.026	0.969-1.086	-0.029	0.021	0.971	0.932-1.011	0.629*	0.046	1.876	1.714-2.054
86-90	0.099*	0.039	1.104	1.022-1.192	-0.031	0.025	0.970	0.922-1.019	0.870*	0.047	2.388	2.178-2.618
91+	0.173*	0.046	1.189	1.088-1.300	-0.046	0.028	0.955	0.904-1.010	1.179*	0.048	3.250	2.961-3.568
Gender												
Male (reference)												
Female	-0.055*	0.018	0.947	0.913-0.981	-0.155*	0.013	0.856	0.835-0.878	-0.266*	0.026	0.767	0.728-0.808
Race												
White (reference)												
Black	-0.118*	0.032	0.889	0.835-0.947	-0.007	0.024	0.993	0.947-1.041	-0.229*	0.035	0.796	0.743-0.853
Hispanic	0.013	0.031	1.013	0.953-1.078	0.038	0.023	1.039	0.993-1.088	-0.277*	0.054	0.758	0.682-0.842
Asian	-0.024	0.100	0.976	0.802-1.188	-0.135	0.079	0.874	0.748-1.021	-0.552*	0.177	0.576	0.407-0.815
Native American	0.226*	0.104	1.253	1.022-1.537	0.108	0.071	1.114	0.970-1.280	0.047	0.127	1.048	0.817-1.345
Other	-0.177*	0.051	0.838	0.757-0.926	-0.077*	0.032	0.926	0.870-0.986	0.068	0.071	1.071	0.931-1.231
Urban/Rural Residence												
Urban (reference)												
Rural	-0.033	0.040	0.967	0.895-1.046	0.057*	0.023	1.058	1.011-1.108	-0.145*	0.040	0.865	0.800-0.936
Dual Eligible Status												
Medicaid-only (reference)												
Dual Eligible	-0.032	0.066	0.968	0.851-1.102	0.158*	0.049	1.171	1.064-1.287	-0.383*	0.070	0.682	0.595-0.782

Appendix 20: Potentially Preventable Hospitalizations among Elderly Medicaid Home and Community-based Users Compared with Nursing Home Residents – Second Stage Multinomial Logit Results for Instrumental Variable Model from Analysis with One Observation per Individual

	Potentially Preventable Hospitalization				Non-Potentially Preventable Hospitalization				Died			
Reason for Medicaid Eligibility												
Poverty/Cash (reference)												
Medically Needy/Other	0.105*	0.033	1.111	1.042-1.184	0.098*	0.021	1.103	1.059-1.150	0.577*	0.065	1.780	1.567-2.023
Diagnosis												
Anemia	0.108*	0.021	1.114	1.069-1.161	0.218*	0.015	1.243	1.207-1.281	0.049*	0.022	1.050	1.006-1.096
Anxiety	0.130*	0.027	1.139	1.082-1.200	0.113*	0.021	1.119	1.074-1.167	-0.074	0.042	0.929	0.855-1.009
Arthritis	-0.003	0.020	0.997	0.958-1.037	0.042*	0.015	1.043	1.013-1.075	-0.286*	0.023	0.751	0.718-0.785
Cancer	0.047	0.028	1.048	0.992-1.107	0.168*	0.022	1.183	1.134-1.234	0.330*	0.033	1.391	1.303-1.485
Chronic Kidney Disease	0.271*	0.026	1.311	1.246-1.380	0.351*	0.015	1.420	1.379-1.463	0.459*	0.029	1.583	1.495-1.676
COPD	0.607*	0.019	1.835	1.769-1.903	0.152*	0.017	1.165	1.127-1.203	0.212*	0.025	1.236	1.178-1.297
Dementia	0.008	0.030	1.008	0.951-1.069	0.065*	0.021	1.067	1.025-1.112	0.135*	0.029	1.145	1.082-1.212
Depression	0.040	0.021	1.041	0.999-1.085	0.059*	0.015	1.061	1.030-1.093	-0.044	0.025	0.957	0.911-1.006
Diabetes	0.265*	0.021	1.303	1.252-1.357	0.160*	0.014	1.173	1.141-1.207	-0.058*	0.026	0.943	0.896-0.993
Heart Failure	0.542*	0.023	1.720	1.644-1.801	0.205*	0.016	1.228	1.189-1.268	0.304*	0.024	1.355	1.294-1.419
Hypertension	-0.026	0.020	0.974	0.936-1.014	0.038*	0.014	1.039	1.010-1.069	-0.326*	0.027	0.722	0.685-0.761
Ischemic Heart Disease	0.199*	0.021	1.220	1.171-1.271	0.210*	0.015	1.234	1.199-1.270	0.023	0.023	1.024	0.979-1.070
Stroke	0.070*	0.023	1.073	1.026-1.121	0.142*	0.018	1.153	1.114-1.194	0.099*	0.029	1.104	1.043-1.169
Previous Hospitalization												
No (reference)												
Yes	0.675*	0.019	1.964	1.893-2.037	0.629*	0.014	1.876	1.824-1.930	1.001*	0.026	2.721	2.585-2.864
Number of hospital beds per 1000 population 65+ in county (10s)	0.012*	0.005	1.012	1.002-1.023	0.007	0.004	1.007	0.999-1.015	-0.015*	0.006	0.985	0.974-0.996

Appendix 20: Potentially Preventable Hospitalizations among Elderly Medicaid Home and Community-based Users Compared with Nursing Home Residents – Second Stage Multinomial Logit Results for Instrumental Variable Model from Analysis with One Observation per Individual

	Potentially Preventable Hospitalization				Non-Potentially Preventable Hospitalization				Died			
Per Capita County Income (1000s)	-0.008*	0.003	0.992	0.987-0.997	0.000	0.002	1.000	0.997-1.004	0.001	0.004	1.001	0.994-1.008

Coef = Coefficient estimate; SE = Standard error; RRR = Relative risk ratio; 95% CI = 95% Confidence interval; COPD = Chronic Obstructive Pulmonary
    Disease
*p<0.05
Model also included categorical variables for quarter of observation and component economic area of residence

Appendix 21: Potentially Preventable Hospitalizations among Elderly Medicaid Home and Community-based Users Compared with Nursing Home Residents – First Stage Logit Results for Instrumental Variable Model from Analysis Excluding the Control Variable for Any Previous Hospitalization

Variable	Coefficient	Standard Error
Instruments		
Home Health Care Services Employees per 1000 population 65+ in county	0.0005*	0.0001
Homes for the Elderly Employees per 1000 population 65+ in county	0.0005	0.0029
Services for the Elderly and Persons with Disabilities Employees per 1000 population 65+ in county	0.0031*	0.0007
Nursing Home Employees per 1000 population 65+ in county	-0.0046*	0.0007
Age		
65-70 (reference)		
71-75	-0.1527*	0.0213
76-80	-0.3841*	0.0270
81-85	-0.6167*	0.0330
86-90	-0.8816*	0.0339
91+	-1.2670*	0.0420
Gender		
Male (reference)		
Female	0.3663*	0.0186
Race		
White (reference)		
Black	0.7624*	0.0943
Hispanic	0.8380*	0.0381
Asian	0.5259*	0.1536
Native American	0.4288*	0.1881
Other	0.5990*	0.0989
Urban/Rural Residence		
Urban (reference)		
Rural	-0.0214	0.0467
Dual Eligible Status		

Appendix 21: Potentially Preventable Hospitalizations among Elderly Medicaid Home and Community-based Users Compared with Nursing Home Residents – First Stage Logit Results for Instrumental Variable Model from Analysis Excluding the Control Variable for Any Previous Hospitalization

Variable	Coefficient	Standard Error
Medicaid-only (reference)		
Dual Eligible	0.6137*	0.1006
Reason for Medicaid Eligibility		
Poverty/Cash (reference)		
Medically Needy/Other	-1.6558*	0.0878
Diagnosis		
Anemia	-0.6948*	0.0319
Anxiety	0.0190	0.0235
Arthritis	0.4565*	0.0251
Cancer	0.4347*	0.0173
Chronic Kidney Disease	0.2255*	0.0255
COPD	0.3895*	0.0293
Dementia	-1.7933*	0.0324
Depression	-0.9880*	0.0324
Diabetes	-0.0963*	0.0165
Heart Failure	-0.4850*	0.0414
Hypertension	0.3565*	0.0268
Ischemic Heart Disease	0.3770*	0.0167
Stroke	-0.5761*	0.0241
Number of hospital beds per 1000 population 65+ in county (10s)	0.0078	0.0077
Per Capita County Income (1000s)	-0.0312*	0.0045

COPD = Chronic Obstructive Pulmonary Disease

*p<0.05

Model also included categorical variables for quarter of observation and component economic area of residence

Appendix 22: Potentially Preventable Hospitalizations among Elderly Medicaid Home and Community-based Users Compared with Nursing Home Residents – Second Stage Multinomial Logit Results for Instrumental Variable Model from Analysis Excluding the Control Variable for Any Previous Hospitalization

	Potentially Preventable Hospitalization				Non-Potentially Preventable Hospitalization				Died			
Variable	**Coef**	**SE**	**RRR**	**95% CI**	**Coef**	**SE**	**RRR**	**95% CI**	**Coef**	**SE**	**RRR**	**95% CI**
Long-term Care Group												
Nursing Home (reference)												
HCBS	0.462*	0.042	1.587	1.462-1.723	0.407*	0.035	1.502	1.404-1.608	-0.721*	0.040	0.486	0.449-0.526
Residual from first stage	-0.029*	0.014	0.972	0.945-0.999	-0.024*	0.011	0.976	0.955-0.999	0.004	0.016	1.004	0.974-1.035
Age												
65-70 (reference)												
71-75	0.016	0.013	1.017	0.990-1.043	-0.002	0.010	0.998	0.979-1.018	0.185*	0.024	1.203	1.148-1.261
76-80	0.036*	0.017	1.036	1.002-1.071	-0.025*	0.012	0.975	0.954-0.998	0.383*	0.022	1.467	1.407-1.530
81-85	0.073*	0.021	1.076	1.033-1.121	-0.025	0.013	0.975	0.951-1.000	0.566*	0.023	1.761	1.684-1.842
86-90	0.120*	0.028	1.128	1.068-1.190	-0.014	0.015	0.986	0.957-1.016	0.789*	0.025	2.201	2.096-2.310
91+	0.194*	0.032	1.215	1.140-1.294	-0.036	0.021	0.964	0.925-1.005	1.119*	0.026	3.063	2.912-3.222
Gender												
Male (reference)												
Female	-0.053*	0.010	0.949	0.930-0.968	-0.131*	0.008	0.877	0.864-0.890	-0.246*	0.012	0.782	0.763-0.801
Race												
White (reference)												
Black	-0.082*	0.020	0.921	0.886-0.958	-0.005	0.014	0.995	0.968-1.023	-0.285*	0.024	0.752	0.718-0.788
Hispanic	-0.008	0.015	0.992	0.962-1.022	0.026	0.013	1.027	1.000-1.054	-0.241*	0.032	0.786	0.738-0.836
Asian	-0.144*	0.071	0.866	0.754-0.995	-0.091	0.056	0.913	0.818-1.019	-0.490*	0.075	0.612	0.529-0.709
Native American	0.234*	0.061	1.263	1.121-1.424	0.203*	0.036	1.225	1.143-1.314	-0.006	0.086	0.994	0.840-1.177
Other	-0.060*	0.025	0.942	0.897-0.989	-0.022	0.018	0.978	0.944-1.013	0.066	0.034	1.068	0.999-1.142
Urban/Rural Residence												
Urban (reference)												
Rural	-0.047	0.034	0.954	0.893-1.019	0.058*	0.019	1.060	1.021-1.100	-0.070*	0.027	0.932	0.884-0.983
Dual Eligible Status												
Medicaid-only (reference)												
Dual Eligible	-0.093*	0.036	0.911	0.849-0.978	-0.005	0.026	0.995	0.946-1.046	-0.414*	0.057	0.661	0.591-0.740

Appendix 22: Potentially Preventable Hospitalizations among Elderly Medicaid Home and Community-based Users Compared with Nursing Home Residents – Second Stage Multinomial Logit Results for Instrumental Variable Model from Analysis Excluding the Control Variable for Any Previous Hospitalization

	Potentially Preventable Hospitalization				Non-Potentially Preventable Hospitalization				Died			
Reason for Medicaid Eligibility												
Poverty/Cash (reference)												
Medically Needy/Other	0.086*	0.016	1.089	1.056-1.124	0.100*	0.016	1.106	1.071-1.141	0.573*	0.072	1.773	1.539-2.042
Diagnosis												
Anemia	0.153*	0.011	1.165	1.140-1.191	0.257*	0.011	1.293	1.266-1.320	0.144*	0.014	1.155	1.124-1.187
Anxiety	0.166*	0.013	1.181	1.152-1.210	0.116*	0.008	1.123	1.106-1.140	-0.034*	0.016	0.967	0.937-0.997
Arthritis	-0.045*	0.014	0.956	0.931-0.982	0.019	0.011	1.019	0.998-1.041	-0.233*	0.013	0.792	0.772-0.813
Cancer	0.085*	0.013	1.089	1.062-1.116	0.191*	0.012	1.210	1.182-1.239	0.374*	0.019	1.454	1.401-1.508
Chronic Kidney Disease	0.364*	0.018	1.439	1.391-1.490	0.419*	0.009	1.521	1.493-1.548	0.582*	0.017	1.790	1.731-1.851
COPD	0.662*	0.012	1.939	1.894-1.985	0.247*	0.008	1.280	1.259-1.302	0.298*	0.014	1.347	1.310-1.385
Dementia	0.112*	0.023	1.119	1.068-1.171	0.139*	0.020	1.149	1.104-1.196	0.332*	0.018	1.393	1.345-1.443
Depression	0.082*	0.012	1.086	1.061-1.111	0.084*	0.010	1.088	1.066-1.110	-0.065*	0.013	0.937	0.913-0.962
Diabetes	0.267*	0.010	1.306	1.281-1.331	0.159*	0.008	1.172	1.155-1.190	-0.029*	0.011	0.971	0.951-0.991
Heart Failure	0.588*	0.017	1.800	1.740-1.862	0.267*	0.010	1.306	1.281-1.332	0.327*	0.014	1.387	1.351-1.425
Hypertension	0.007	0.011	1.007	0.985-1.030	0.063*	0.009	1.065	1.047-1.083	-0.258*	0.015	0.772	0.750-0.795
Ischemic Heart Disease	0.277*	0.010	1.320	1.294-1.346	0.269*	0.007	1.308	1.290-1.327	0.135*	0.012	1.145	1.118-1.171
Stroke	0.137*	0.014	1.146	1.114-1.179	0.208*	0.013	1.231	1.200-1.263	0.159*	0.014	1.172	1.142-1.204
Number of hospital beds per 1000 population 65+ in county (10s)	0.007	0.005	1.008	0.998-1.017	0.010*	0.003	1.010	1.003-1.016	-0.008	0.004	0.992	0.983-1.001
Per Capita County Income (1000s)	-0.010*	0.003	0.991	0.985-0.997	-0.001	0.001	0.999	0.997-1.002	-0.002	0.002	0.998	0.993-1.003

Coef = Coefficient estimate; SE = Standard error; RRR = Relative risk ratio; 95% CI = 95% Confidence interval; COPD = Chronic Obstructive Pulmonary Disease

*p<0.05

Model also included categorical variables for quarter of observation and component economic area of residence
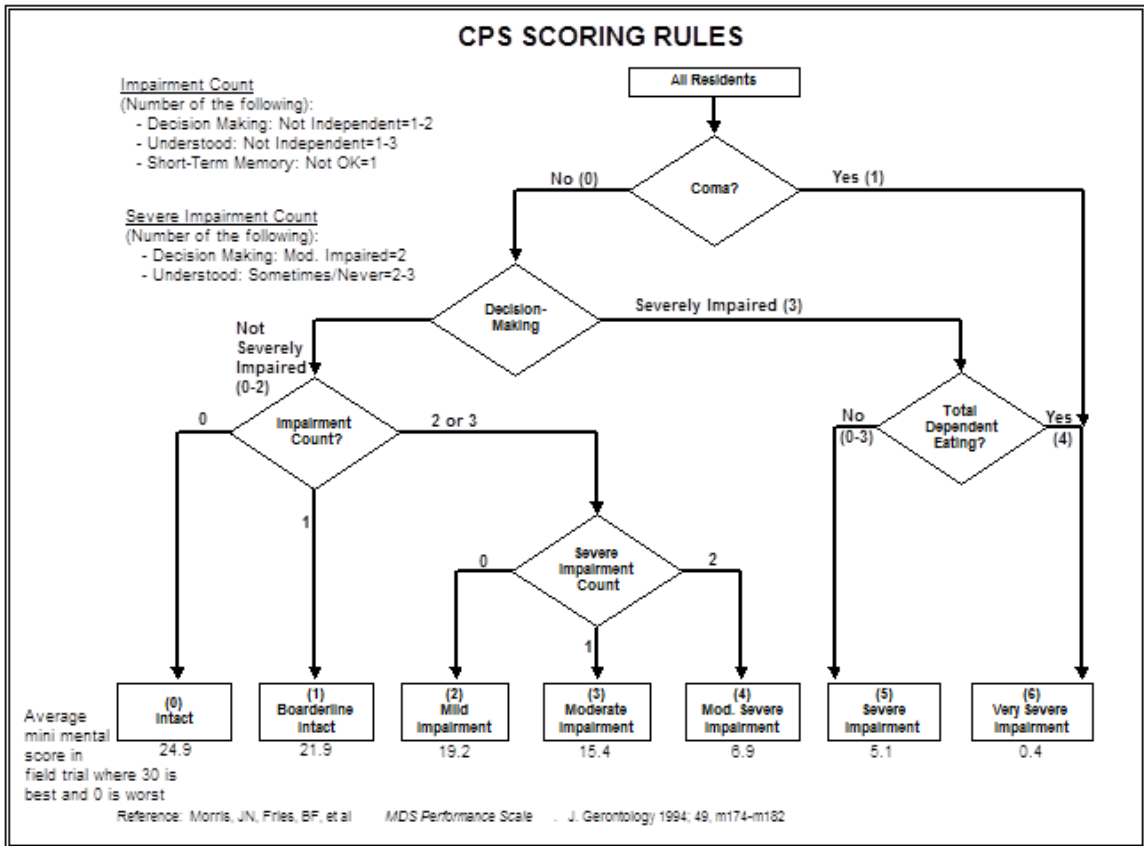
Appendix 23: Description of Minimum Data Set Activities of Daily Living (ADL) Long Form Scale

Item	MDS Version 2.0 Question	Description
Bed mobility	G1Aa	How resident moves to and from lying position, turns side to side, and positions body while in bed
Transfer	G1Ab	How resident moves between surfaces – to/from: bed, chair, wheelchair, standing position (excluding to/from bath/toilet)
Locomotion on unit	G1Ae	How resident moves between locations in his/her room and adjacent corridor on same floor (if in wheelchair, self-sufficiency once in chair)
Dressing	G1Ag	How resident puts on, fastens, and takes off all items of street clothing, including donning/removing prosthesis
Eating	G1Ah	How resident eats and drinks (regardless of skill); includes intake of nourishment by other means (e.g., tube feeding, total parenteral nutrition)
Toilet use	G1Ai	How resident uses the toilet room (or commode, bedpan, urinal); transfer on/off toilet, cleanses, changes pad, manages ostomy or catheter, adjusts clothes
Personal hygiene	G1Aj	How resident maintains personal hygiene, including combing hair, brushing teeth, shaving, applying makeup, washing/drying face, hands, and perineum (excluding baths and showers)

Categories of responses to each item include:
0. Independent – No help or oversight – OR – Help/oversight provided only 1 or 2 times during last 7 days
1. Supervision – Oversight, encouragement or cueing provided 3 or more times during last 7 days – OR – supervision (3 or more times) plus physical assistance provided only 1 or 2 times during last 7 days.
2. Limited Assistance – Resident highly involved in activity; received physical help in guided maneuvering of limbs or other nonweight bearing assistance 3 or more times – OR – more help provided only 1 or 2 times during last 7 days.
3. Extensive Assistance – While resident performed part of activity, over last 7-day period, help of following type(s) provided 3 or more times: (1) weight-bearing support, (2) full staff performance during part (but not all) of last 7 days.
4. Total Dependence – Full staff performance of activity during entire 7 days.
8. Activity did not occur – during entire 7 days.
   • For this scale, category 8 is combined with category 4.

Appendix 24: Description of Cognitive Performance Scale (CPS)

CPS SCORING RULES

Impairment Count
(Number of the following):
  - Decision Making: Not Independent=1-2
  - Understood: Not Independent=1-3
  - Short-Term Memory: Not OK=1

Severe Impairment Count
(Number of the following):
  - Decision Making: Mod. Impaired=2
  - Understood: Sometimes/Never=2-3

All Residents

Coma? — No (0) / Yes (1)

Decision-Making — Not Severely Impaired (0-2) / Severely Impaired (3)

Impairment Count? — 0 / 1 / 2 or 3

Total Dependent Eating? — No (0-3) / Yes (4)

Severe Impairment Count — 0 / 1 / 2

| (0) Intact | (1) Boarderline Intact | (2) Mild Impairment | (3) Moderate Impairment | (4) Mod. Severe Impairment | (5) Severe Impairment | (6) Very Severe Impairment |

Average mini mental score in field trial where 30 is best and 0 is worst

| 24.9 | 21.9 | 19.2 | 15.4 | 6.9 | 5.1 | 0.4 |

Reference: Morris, JN, Fries, BF, et al   MDS Performance Scale   . J. Gerontology 1994; 49, m174~m182

Appendix 25: Characteristic Distribution of Nursing Home Stayers and Nursing Home Transitioners after Matching (Mean)

Variable	Nursing Home Stayers	Nursing Home Transitioners	p-value
Activities of Daily Living Score	12.982	13.294	0.223
Cognitive Performance Scale Score	1.7353	1.7889	0.255
Chronic Illness and Disability Payment System Score	0.6355	0.6991	0.060
Year of Nursing Home Admission	2003.8	2003.8	0.683
Age	2.26	2.3079	0.317
Gender	0.7312	0.7266	0.745
Urban/Rural Residence	0.2600	0.2714	0.424
Reason for Medicaid Eligibility	0.7817	0.7709	0.419
Race	0.4743	0.5299	0.084

Appendix 26: Graph of Common Support for Matched Nursing Home Stayers and Nursing Home Transitioners
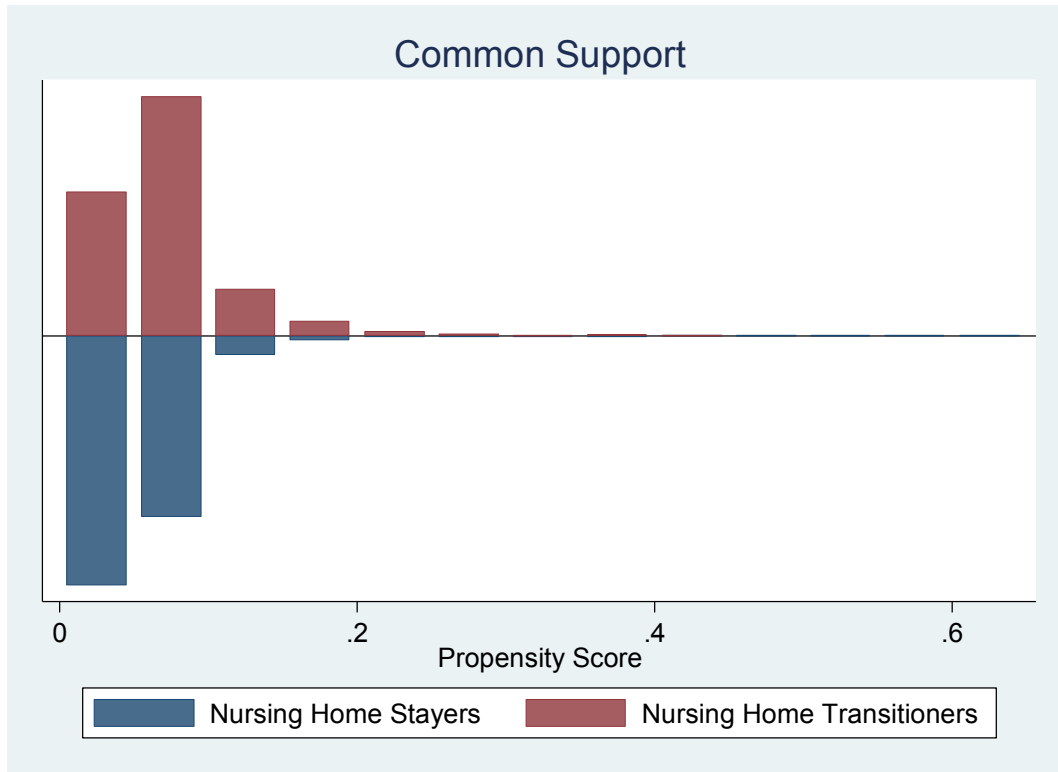
Appendix 27: Sample Description of Elderly Medicaid Nursing Home Stayers and Nursing Home Transitioners for Any Type of Hospitalization

| Variable	Nursing Home Stayers (N = 1,169)	Nursing Home Transitioners (N = 1,169)
Event		
Any Type of Hospitalization	297 events/ 334,076 time at risk 25.41% had event	419 events/ 274,696 time at risk 35.84%* had event

*p<0.05

Appendix 28: Any Type of Hospitalization among Nursing Home Transitioners Compared with Nursing Home Stayers – Cox Proportional Hazards Model Results
(N = 2,338)

Variable	Hazard Ratio [95% Confidence Interval]
Group	
Nursing Home Stayers (reference)	
Nursing Home Transitioners	1.535* [1.291-1.824]
Age	
65-70 (reference)	
71-75	0.917 [0.632-1.331]
76-80	0.936 [0.654-1.340]
81-85	0.970 [0.668-1.411]
86-90	0.802 [0.537-1.198]
91+	0.539* [0.337-0.862]
Gender	
Male (reference)	
Female	0.790 [0.614-1.017]
Race	
White (reference)	
Black	0.859 [0.587-1.257]
Hispanic	0.970 [0.686-1.371]
Other	1.656 [0.825-3.324]
Urban/Rural Residence	
Urban (reference)	
Rural	1.217 [0.959-1.546]
Reason for Medicaid Eligibility	
Poverty/Cash (reference)	
Medically Needy/Other	1.513* [1.079-2.122]
Diagnosis	
Anemia	1.348* [1.068-1.702]
Anxiety	1.409* [1.053-1.884]
Arthritis	0.985 [0.790-1.229]
Cancer	0.959 [0.687-1.338]
Chronic Kidney Disease	1.286 [0.976-1.695]
Chronic Obstructive Pulmonary Disease	1.751* [1.388-2.210]
Dementia	0.990 [0.789-1.241]
Depression	0.928 [0.733-1.175]
Diabetes	1.162 [0.926-1.459]
Heart Failure	1.431* [1.137-1.802]
Hypertension	0.870 [0.645-1.173]
Ischemic Heart Disease	1.382* [1.113-1.717]
Stroke	1.306* [1.030-1.657]
Activities of Daily Living score	1.018* [1.002-1.034]
Cognitive Performance Scale score	0.909* [0.834-0.991]

*p<0.05

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Appendix 29: Graph of Estimated Cumulative Hazard for Any Type of Hospitalization among Nursing Home Stayers and Nursing Home Transitioners

Estimated Cumulative Hazard

Nursing Home Stayers — Nursing Home Transitioners
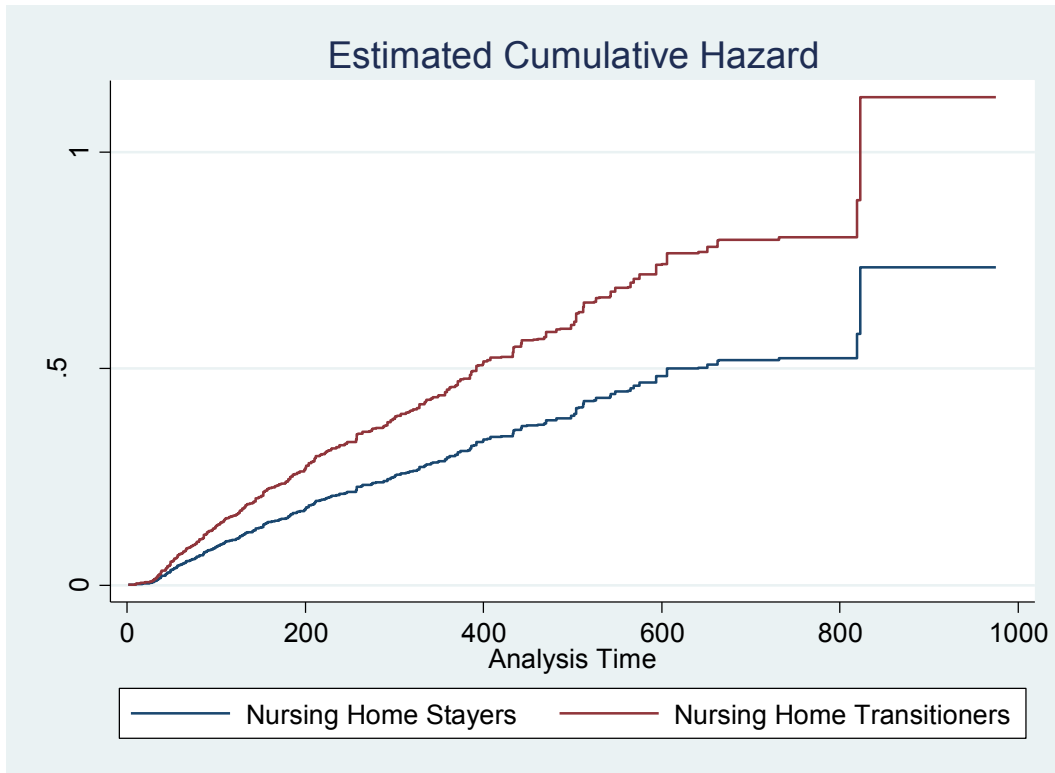
Appendix 30: Potentially Preventable Hospitalizations among Nursing Home Transitioners Compared with Nursing Home Stayers for Individuals with Heart Failure – Cox Proportional Hazards Model Results

(N = 1,084)

149 events/305,230 time at risk

Variable	Hazard Ratio [95% Confidence Interval]
Group	
Nursing Home Stayers (reference)	
Nursing Home Transitioners	1.305 [0.910-1.872]

*p<0.05

Model also controlled for age, gender, race, urban/rural residence, reason for Medicaid eligibility, diagnoses, activity of daily living score, cognitive performance scale score

Appendix 31: Any Type of Hospitalization among Nursing Home Transitioners Compared with Nursing Home Stayers for Individuals with Heart Failure – Cox Proportional Hazards Model Results

(N = 1,052)

395 events/237,810 time at risk

Variable	Hazard Ratio [95% Confidence Interval]
Group	
Nursing Home Stayers (reference)	
Nursing Home Transitioners	1.548* [1.215-1.971]

*p<0.05

Model also controlled for age, gender, race, urban/rural residence, reason for Medicaid eligibility, diagnoses, activity of daily living score, cognitive performance scale score

Appendix 32: Potentially Preventable Hospitalizations among Nursing Home Transitioners Compared with Nursing Home Stayers for Individuals with Ischemic Heart Disease – Cox Proportional Hazards Model Results

(N = 1,146)

141 events/333,756 time at risk

Variable	Hazard Ratio [95% Confidence Interval]
Group	
Nursing Home Stayers (reference)	
Nursing Home Transitioners	1.198 [0.841-1.705]

*p<0.05

Model also controlled for age, gender, race, urban/rural residence, reason for Medicaid eligibility, diagnoses, activity of daily living score, cognitive performance scale score

Appendix 33: Any Type of Hospitalization among Nursing Home Transitioners Compared with Nursing Home Stayers for Individuals with Ischemic Heart Disease – Cox Proportional Hazards Model Results

(N = 1,109)

405 events/252,944 time at risk

Variable	Hazard Ratio [95% Confidence Interval]
Group	
Nursing Home Stayers (reference)	
Nursing Home Transitioners	1.542* [1.218-1.954]

*p<0.05

Model also controlled for age, gender, race, urban/rural residence, reason for Medicaid eligibility, diagnoses, activity of daily living score, cognitive performance scale score