Examining Long-Term Care Episodes and Care History for Medicare Beneficiaries:

A Longitudinal Analysis of Elderly Individuals Entering Nursing Homes

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A. Introduction

The leading edge of the Baby Boom generation will reach age 65 in five years, beginning a demographic surge that will continue for roughly 20 more years. At the same time, individuals are living longer, and facing a potentially longer period of need for long-term care services in order to assist them in activities of daily living and in managing chronic medical conditions. While home and community-based services (HCBS) are a growing, and preferred, form of care for many consumers, residential services will remain a needed form of care, particularly for those without social support and those with greater medical and assistive needs.

Estimates of the risk of any nursing home use among the elderly range from 35% to 55%, and the risk of residing in nursing homes more than five years ranges from 12% to 21% (Murtaugh et al, 1997). Estimates of the average length of total stays among users range from almost 2 to almost 3 years (Murtaugh et al. (1997). Several factors influence nursing home entry among the elderly, including older age, higher level of disability, lack of social support, and being female and white (Coughlin, McBride, and Liu 1990; Wolinsky et al. 1992; Murtaugh et al. 1997).

Federal and state policy makers, as well as advocates for the elderly, are grappling with means to best to finance and provide long-term care services, and to integrate and coordinate them with health care and other social support services. While HCBS use and spending is growing, nursing facilities remain the largest provider of formal long-term care. Total public and private spending for nursing home care (non-skilled care) totaled about $106 billion in 2002, with over one-third ($39 billion) paid by Medicaid (Centers for Medicare and Medicaid Services (CMS) 2006). Nursing home spending is about 18% of all Medicaid spending (CMS 2006). Nursing home use is a common avenue to Medicaid eligibility, due to less restrictive Medicaid eligibility rules for nursing home residents and the high cost of this care. In 2002, Medicaid spending per nursing home user averaged over $22,000 (CMS 2006).

Given the continued need for residential care among the elderly, it is important to have current estimates of the risk for nursing home entry and length of nursing home stays, and as well as an understanding of the health care utilization patterns of residents. There is a large body of literature on the predictors of nursing home use, such as the studies reviewed by Miller and Weissert (2000) and Taylor and colleagues (2005), however there are fewer nationally-representative studies that have explored the health care utilization and spending of nursing home residents over the course of their stays.

This study helps fill this gap by conducting forward-looking" and "backward-looking" analyses of a cohort of nursing home entrants in order to assess risk for nursing home entry and key events after admission, such as hospitalization, Medicaid enrollment, and nursing home discharge. Several years of information from Medicare and Medicaid administrative data and nursing home patient assessment information were used. This type of study was feasible because, after years of development, CMS data resources now

include a national, longitudinal electronic warehouse of nursing home patient assessment information as well as Medicaid files that can link with these patient assessment data and Medicare administrative data. These recently available and developed data sources offer exciting opportunities for better understanding the health and service use trajectories of beneficiaries, and understanding where policy may be able to affect outcomes and trajectories.

This report is the third in this CMS-sponsored project using these data files to analyze the health care trajectories of individuals using or at risk for long-term care. The requirements of the overall project are unique in their depth and breadth of activity. In its first phase, we developed several specific policy and research questions that could be explored using these data; identified a theoretical framework for long-term care risk; and presented a methodological and empirical underpinning for the integrated analysis of Medicare and long-term care use among the elderly. We then designed and discussed multiple population cohorts that can support a range of policy-relevant analyses using these data, and developed detailed analytic and statistical analysis plans for three cohorts. These activities are detailed in the report *Examining Long-Term Care Episodes and Care History for Medicare Beneficiaries: Analytic Framework and Analysis Plan* (Maxwell et al, 2004). With CMS project staff, we then selected two of the population cohorts for quantitative analysis.

The second phase of the project involved obtaining and constructing analytic files for the two population cohorts for longitudinal analysis. The first cohort consisted of elderly experiencing their first hospitalization for congestive heart failure (CHF) and used several years' worth of Medicare enrollment data, 100% Medicare Parts A and B claims data, nursing home patient assessment records, and area-level files. The second cohort consists of elderly Medicare beneficiaries newly admitted to a nursing home (from either the community or continuing on after a Medicare-covered skilled stay) and used several years' worth of nursing home patient assessment records, Medicare enrollment data, 100% Medicare Part A claims data, Medicaid claims files for two states, and other provider-level and area-level files.

The report, *A Longitudinal Analysis of Elderly Individuals with Congestive Heart Failure* (Maxwell and Waidmann 2006), describes findings regarding the CHF cohort, including trends in Medicare use and spending by type of service, and risks for outcomes including CHF hospitalization, hospitalization other than for CHF, nursing home entry, Medicaid enrollment, and death. The multivariate models of events estimate the effects of covariates on the instantaneous risk of an outcome, through measuring the elapsed time before an outcome is observed. Two-part models estimate use and level of spending by type of Medicare service.

This report describes the cohort selection methods, data sources and statistical methods, and findings regarding a cohort of elderly who were admitted for the first time to a nursing home in 1999.

1. Overview of the Cohort of Nursing Home Entrants

The cohort is comprised of elderly who were newly admitted to a nursing facility, as Medicaid-covered residents or as private-pay residents, in 1999. In cases where multiple admissions in the year were identified for an individual, the first admission was selected. We scanned nursing home patient assessment data and Medicaid nursing home claims prior to the 1999 admissions identified, to restrict the cohort to new entrants.

The primary analytic focus of the cohort was to assess the trajectory of health-related events and expenditures of the residents over a 36-month study period following admission, as well as the determinants of and time to Medicaid enrollment. A secondary focus was to examine the course of hospital and SNF events in the 12 months leading up to nursing home admission, to help understand the risks associated with nursing home entry.

To permit these analyses, we used primarily Medicare and Medicaid claims and enrollment data and nursing home patient assessment information. Data on nursing home and area characteristics were used as well.

2. State Selection

Due to resource constraints involved in processing Medicaid files, we restricted our analyses to two states, New Jersey and Minnesota, and analyzed these state cohorts separately. We selected the states based on several criteria including Medicaid data quality, HCBS participation rate, geographic representation, and sample size. After consultation with CMS staff and long-term care policy experts, we narrowed the range of potential states to 13 states that are diverse in terms of their geography and Medicaid programs yet are all fairly large in terms of the potential sample size of nursing home entrants.[1]

To assess the Medicaid data quality of the 13 states we reviewed two sets of ongoing, CMS-sponsored reports on Medicaid data quality: *Medicaid MAX Data Anomalies* (Mathematica Policy Research (MPR) 2004a) and *Medicaid MAX Data Verification* (MPR 2004b) and consulted with the authors. These reports provide tabulations of numerous data fields in each type of Medicaid administrative file by state and by year (e.g., nursing home admissions, death dates, prescription drug spending). They summarize anomalies and data limitations by file type and by state, such as fields with frequently missing data or fields with aberrant average values relative to values from the surrounding years. Of the states examined, three were excluded from consideration based on data quality (Alabama, Texas, Florida).

Nursing home utilization varies across states, in part due to differences in state Medicaid regulations and use of HCBS. HCBS refers to programs that care for elderly or disabled individuals in the community setting who require a nursing facility level of care

[1] Alabama, California, Colorado, Florida, Massachusetts, Michigan, Minnesota, Mississippi, New Jersey, New York, Texas, Washington, and Wisconsin.

and otherwise would reside in them. The combination of federal Medicaid 1915(c) waivers, the "Olmstead" Supreme Court decision in 1999, and recent federal grant monies has spurred states to provide HCBS. While states and localities can develop programs independent of Medicaid, the Medicaid waiver mechanism is generally used because it leverages federal matching funds (Fox-Grange 2004). Since the nature of HCBS available to the elderly, and their participation in these programs, can potentially affect the composition of a state's nursing home population we reviewed these programs and the elderly participation rates of the 13 states. Table A-1 shows the elderly and disabled participations rates (elderly-only rates were not available). We were interested in selected states with contrasting participation rates.

Table A-1. Elderly and disabled 1915c participation rates, selected states

State	1915c elderly/disabled participants per 1000 population
Washington	5.1
Minnesota	3.31
Colorado	3.19
Mississippi	2.55
Wisconsin	2.32
Alabama*	1.63
Texas*	1.45
Michigan	1.44
Florida*	1.09
New York	1.07
Massachusetts	0.95
New Jersey	0.87
California	0.37

*States not further considered for cohort construction, due to Medicaid data problems.
Source: Authors' analyses of state 1915c waiver programs.

Based on our state selection criteria and after conferring with CMS staff, we selected New Jersey and Minnesota. These states provide contrasts in terms of HCBS participation rates and geography, and are acceptable choices in terms of Medicaid data quality and sample size.

B. Data and Methods

1. Data Sources

Several administrative and county-level files were used to construct and analyze the state cohorts of nursing home entrants (Table B-1). MDS records were used to

identify, or populate, the cohorts. Information on residents' cognitive status, functional status, and length of stays also were obtained from MDS records. MDS assessments are completed on all individuals in nursing homes, regardless of payer, upon admission and at periodic intervals. The MDS is part of an overall nursing home resident assessment system, required by the Nursing Home Reform Act of OBRA 1987, which was developed to improve the health and quality of life of nursing home residents. CMS developed an ongoing national electronic repository of all MDS assessments beginning in July 1998, following implementation of the Medicare skilled nursing facility (SNF) prospective payment system (PPS).

To identify health care utilization and spending and dual-eligibility status of the entrants, we used Medicare enrollment and claims files and Medicaid claims files. Due to the resource intensity associated with processing the 100% files of Medicare Part B data, we limited our Medicare utilization and spending analyses to Part A (stays in acute hospitals, skilled nursing facilities, and specialty hospitals). We obtained Medicaid use and spending information from long-term care claims files (for nursing home use) and the person summary files. The person summary files were used to identify month of Medicaid enrollment and to create monthly, 12-month, and 36-month summaries of Medicaid prescription drug spending and Medicaid spending other than nursing home and drug spending.

Nursing facility characteristics were identified from CMS's Provider of Service file. This is an annual file created from the state survey and certification process, and is often used by researchers to identify and characterize providers that participate in Medicare and Medicaid. The Area Resource File (ARF), maintained by the Bureau of Health Professions, was used to identify several county-level characteristics. These provide an overall picture of an area's socio-demographic profile, illness burden, and supply of health care professionals and facilities. InterStudy data were used to identify county-level participation rates in health maintenance organizations (HMOs). Several rates were constructed and tested, including elderly participation in Medicare plans; all-age participation in Medicaid plans, and all-age participation in all public and private sector plans.

Table B-1. Files used in cohort construction and analysis

- National MDS repository, 1999-2003
- MedPAR (Medicare Provider Analysis and Review) files, 1998-2003
  - Acute hospital stays
  - Specialty hospital stays (i.e., rehabilitation, long-term care, and psychiatric hospital or unit stays)
  - Skilled nursing facility stays
- Medicare denominator files, 1998-2003
- Medicaid "MAX" long-term care claims files, 1999-2002
- Medicaid "MAX" person summary files, 1999-2002
- Provider of Service file, 1999
- Area Resource File, 1999
- InterStudy HMO data file, 2000

2. Cohort Definition and Construction

The main data steps involved in defining and populating the state cohorts are summarized in Table B-2.

Table B-2. Key steps in cohort definition and construction

1. *Obtain MDS records for New Jersey and Minnesota facilities in 1998 through 2003.* This step involved using facility identification and MDS record date fields to extract MDS records for these states and years. A corrected record date field was used ("r-target date" field), which corrects for SNF admission assessments completed after the date of a SNF discharge (a not-uncommon occurrence). The MDS national repository contractor completed this step and delivered us 12 files (files by state by year).

2. *Identify first admission of individuals into a nursing home in 1999 for a non-Medicare-covered stay.* This step involved sorting and analyzing individuals' MDS records by date and by type of record. An algorithm was developed and used to tentatively identify and then confirm whether a record reflected a first-time admission, rather than for example a reentry following a hospital stay, a move between two facilities, or a SNF stay. Originally, SNF admissions who converted to non-SNF beds were included in the cohort. These "SNF to NF" individuals ultimately were excluded from the cohort, due to problems in identifying their month of converting to a non-Medicare bed and in matching that estimated month with periods of other Medicare and Medicaid utilization. Step 2 was processed for each state separately.

3. *Scan pre-1999 MDS records to establish that individuals identified in step 2 can be considered new nursing home entrants.* This step was particularly important for individuals with nursing home admissions in early 1999. We analyzed the date and type of MDS records in the MDS repository in 1998, to exclude individuals identified from step 2 who otherwise would appear to be "new" or "first-time" nursing home admissions.

The number of elderly ultimately identified and used in the state cohorts are shown in Table B-3. After the exclusions, each state cohort consisted of roughly 9,500 elderly.

Table B-3. Number of cohort members remaining after initial edits

Exclusion Rule	New Jersey	Minnesota
• Total number of individuals identified in the 1999 MDS	93,177	72,798
• Excluded existing residents, SNF admissions, and other admissions that were not "first" admissions	11,534	10,989
• Excluded individuals with missing Medicare enrollment records, under age 65, or with ESRD	9,855	9,684
• Excluded individuals in facilities with facility id errors or in counties not matching to ARF counties	9,578 (final cohort population)	9,642 (final cohort population)

3. Analytic File Development

Our overall approach to building the analytic files of service utilization and spending necessary for the cohorts was to create a final cohort list for each state (i.e., a list of the Medicare beneficiary identifier codes of the state cohort members) and then create separate utilization files by type of claims provider. Early on in the project we decided against creating a "master" file consisting of all study records and variables, because the size of such a file would be unworkable for our statistical analyses given both the large number of variables we wanted to maintain on the cohort from each type of claim and the large number of years in the study period. Thus, for each claims type and for other main files, the approach we used to create the final statistical files involved the following main steps, described in Table B-4.

Table B-4. Key steps in developing cohort analysis files

MDS patient assessment files:

1. *Analyze MDS type of record and date fields in order to identify first-time, or new, admissions.* Each individual's type of record and record date variables were sorted and analyzed in order to identify MDS records that represented first-time entries to nursing homes for non-skilled (i.e., non-Medicare) stays. The cohort was created from first-time admissions in 1999. As noted above, Medicare SNF patients who had lived in the community but then transitioned to non-Medicare residence status ultimately were excluded from the cohort, due to problems in consistently identifying their month of converting to a non-Medicare bed and in matching that estimated month with periods of other Medicare and Medicaid utilization.

2. *Extract and Keep Entire Records of the Cohort.* All MDS records of the cohort members were extracted and stored as state-annual files (1999-2003) from the 100% files of the New Jersey and Minnesota files.

3. *Construct Cognitive Status, Physical Function Status, and Discharge Status Variables.* The main MDS fields used for analyses included items on cognitive performance and activities of daily living (MDS sections B and G). Length of nursing home residence was identified by analyzing an individual's pattern of MDS assessment types (using the MDS type of record field) and MDS record date fields over the 36-month period from an individual's month of entry, and cross-checking with death indicators on Medicare enrollment files.

Medicare utilization and enrollment files:

4. *Extract Medicare enrollment and MedPAR Records*. Cohort members' Medicare enrollment and MedPAR records were extracted and stored as state-annual files (1998-2003).

5. *Construct Comorbidity, Medicare Spending and Utilization, and Medicaid Enrollment Variables.* 1998-1999 MedPAR records were used to construct baseline (upon NF admission) comorbidity variables. 1999-2003 MedPAR records were used to construct 30-day, quarterly, 360-day, and total (36-month) of utilization and spending by type of service. Variables were constructed starting at NF admission date and ending with either death, discharge from facility without relocation to a new facility, or the end of the 36-month study period. 1998-2003 Medicare enrollment records were used to create variables indicating month of Medicaid buy-in and death.

Table B-4. (continued) Key steps in developing cohort analysis files

Medicaid long-term care and person summary files:

6. *Extract Medicaid Nursing Home Claims and Person Summary Records*. Medicaid-covered nursing home claims are identified as 'type of service = 07' in Medicaid long-term care files. Cohort members' records from each file type were extracted and stored as state-annual files from 1999 through 2002, the latest year of Medicaid data available for the states analyzed.

7. *Construct Medicaid Spending and Utilization Variables.* Medicaid nursing home claims were used to create 30-day, quarterly, 360-day, and total (36-month) variables of Medicaid nursing home spending. Nursing home spending is totaled on the Medicaid annual person summary files— these summary amounts were validated from the claims. The summary files provide annual Medicaid utilization and spending summaries by type of service. These fields were used to construct 30-day, etc. variables of Medicaid prescription drug spending, and Medicaid spending other than for nursing home care and prescription drugs (labeled as "other Medicaid" spending. Thirty-day spending amounts for prescription drugs and "other Medicaid" services were calculated using the total number of Medicaid-enrolled months in the calendar year.

ARF and InterStudy HMO files:

Extract Variables to Control for Area-Level Health Services Supply and Need. Several dozen county-level socio-demographic and health services supply fields were extracted from the 1999 ARF. As needed for analyses, these were merged by cohort members' county of residence. Several types of county-level HMO penetration fields were extracted from InterStudy files.

Ad hoc statistical analysis files:

8. *Create Statistical Analysis Files.* As needed for specific analyses, analytic files were created on an ad hoc basis for bivariate and multivariate statistical analyses.

4. Outcome Variables: Construction and Descriptive Statistics

The main goals of the analyses are to identify long-term patterns in health related events of the nursing home entrants and understand the factors associated with the events. In this section, we describe the six main types of outcomes developed: 1) survival; 2) Medicaid enrollment; 3) discharge to home or assisted living from the nursing home, without reentry; 4) Medicare utilization; 5) Medicare spending; and 6) Medicaid spending. For each cohort member, outcome variables were created in 30-day increments, spanning from the date of nursing home admission listed on the MDS admission record to one of three study endpoints: death; discharge to a lower level of care (home or assisted living) without later admission to another nursing home; or end of study period (36 months past nursing home admission). As described in this section, event dates were identified and compared to an individual's nursing home entry date in order to assign the event to the appropriate 30-day period. The 30-day variables were

required for our hazard analyses (described in Section B-7 below), and were used to produce charts that illustrate the longitudinal experience of the cohorts.

Tables B-5 through B-8 provide descriptive statistics on the outcome variables of the two cohorts, measured at the 36-month point. As Table B-5 shows, across the two cohorts about 43% survived at least the full study period (36 months beyond their nursing home entry date). Death dates were identified from Medicare enrollment files, and then were compared to an individual's nursing home entry date in order to assign the death event to the appropriate 30-day period.

Table B-5. Descriptive Statistics of Outcome Variables

Outcome	Minnesota	New Jersey
Survival		
Alive at 36 months (%)	42.2	44.4
Medicaid enrollment		
Enrollment among cohort (enrollment by month 36 / members in original cohort) (%)	53.1	49.8
Enrollment among survivors (enrollment by month 36 / members alive in month 36) (%)	62.0	53.2
Nursing home discharge rate among cohort (individuals discharged by month 36 / members in original cohort)		
Discharged to home, without reentry (%)	11.1	5.9
Discharged to assisted living facility, without reentry (%)	17.3	27.4
Medicare utilization among cohort (individuals ever admitted by month 36 / members in original cohort)		
Acute hospital admissions (%)	45.4	56.1
Specialty hospital admissions (%)	2.6	2.4
SNF admissions (%)	38.2	36.0
Medicare Part A spending among cohort (spending by month 36 / members in original cohort)		
Total Medicare Part A spending (average $)	8,285	15,369
Acute hospital spending (average $)	4,974	10,958
Specialty hospital spending (average $)	453	254
SNF spending (average $)	2,858	4,157
Medicaid program spending among cohort (spending by month 36 / members in original cohort)		
Total Medicaid spending (average $)	28,289	30,490
Nursing home spending (average $)	23,264	25,576
Prescription drug spending (average $)	875	2,510
Other Medicaid spending (average $)	4,150	2,404
Total spending among cohort (spending by month 36 / members in original cohort)		
Medicare Part A and Medicaid (average $)	36,574	45,858

At 36 months, roughly 50% of the original members of the two cohorts were enrolled in Medicaid. If enrollment by month 36 is examined in relation to only those surviving the full 36 months, the enrollment percentage is substantially higher among the Minnesota cohort (MN: 62.0%; NJ: 53.2%). For some observations we encountered missing Medicaid enrollment information on our main source file, thus we used a hierarchy of possible sources for identifying the month of Medicaid enrollment. First, if the data were present for a cohort member we used the monthly buy-in status indicator from Medicare enrollment files. If this information was missing for an individual, we

checked the monthly eligibility status indicator from the Medicaid person summary files. If this information was missing, we used the month of an individual's first Medicaid nursing home claim.

At 36 months, 11.1% of the Minnesota cohort members were discharged to home, compared to 5.9% of the New Jersey cohort members. While a larger share of the Minnesota cohort was discharged to the home, a larger share of the New Jersey cohort was discharged to assisted living facilities (MN: 17.3%; NJ: 27.4%).[2] The nursing home discharge variables were constructed by analyzing MDS record types and identifying the presence and record type, if any, of MDS records that followed an individual's MDS discharge record. For example, individuals with a discharge record who later had records indicating re-entry to the initial nursing home, or entry into another nursing home, were not coded as "discharged" individuals in the study.

Over the study period, a substantially smaller share of the Minnesota cohort was hospitalized (45.4%) compared to the New Jersey cohort (56.1%). The admission rates among specialty hospitals (rehabilitation, long-term acute care, and psychiatric facilities) are fairly similar across the two cohorts (MN: 2.6%; NJ: 2.4%). SNF admission rates also are fairly similar across the cohorts (MN: 38.2%; NJ: 36.0%). To construct variables indicating the presence of MedPAR events in 30-day increments, we used the admission date on the MedPAR record to assign the MedPAR event to the appropriate 30-day period in relation to an individual's nursing home entry date.

As Table B-5 shows, over the 36-month study period Medicare Part A spending averaged $8,285 per cohort member and $15,369 per member for the full Minnesota and New Jersey cohorts, respectively. Most of the difference was driven by acute hospital spending, which was almost twice as high for the New Jersey cohort (MN: $4,974; NJ: $10,958). With higher acute hospital spending among the New Jersey cohort, it is not surprising that SNF spending is higher among that cohort also (MN: $2,858; NJ: $4,157). To construct Medicare spending variables, we prorated payments from the MedPAR claim across 30-day increments if a MedPAR admission stretched across increments. For example, if 30% of a stay occurred in the 10th 30-day period and 70% of a stay occurred in the 11th 30-day period, then we assigned 30% of the stay's payments to the 10th period and 70% of the payment to the 11th period.

At about $29,000 per cohort member, Medicaid spending was more comparable across the cohorts than Medicare Part A spending. As expected, most of the Medicaid spending was attributable to nursing home payments (about $24,000 per cohort member). As Table B-5 shows, Medicaid prescription drug spending was three times higher per member in the New Jersey cohort (MN: $875; NJ: $2,510), while other Medicaid

[2] In an AHRQ study, Mollica et. al. (2005) compare availability of nursing and assisted living facilities across states. While Minnesota has a larger supply of nursing home beds per elderly resident than New Jersey, a direct comparison of assisted living availability is not possible. Minnesota's Department of Health does not report numbers of assisted living beds, because licensing pertains to agencies that provide "housing with services." These services can be provided in any setting, and thus could be institutional, group, or individual housing.

spending was lower among that cohort (MN: $4,150; NJ: $2,404). Medicaid payments on the Medicaid nursing home claims records were used to construct the nursing home spending variables. As with the Medicare spending variables, we prorated nursing home payments across 30-day increments, in order to construct 30-day spending variables originating with the date of nursing home entry. To construct the Medicaid prescription drug and "all other" Medicaid spending variables, we used the annual Medicaid spending summary variables in the Medicaid person summary files. For each Medicaid-eligible cohort member, we first prorated the annual spending amounts using the total number of Medicaid-enrolled months in the calendar year. For example, if an individual was dually-eligible for 10 months of a calendar year, then their total Medicaid prescription drug spending in that year would be averaged over their 10 months of enrollment.

To further describe the inpatient utilization experience of the two cohorts, Tables B-6 through B-10 show frequencies of inpatient events before and after nursing home admission. As Table B-6 indicates, after nursing home admission the Minnesota cohort incurred fewer hospitalizations than the New Jersey cohort— 56% of the Minnesota cohort were not hospitalized, compared with 44% among the New Jersey cohort. As the bottom panel of Table B-6 indicates, there is less difference between the state cohorts in terms of hospitalization before nursing home admission.

Table B-6. Frequencies of Medicare acute hospitalizations before and after nursing home admission

	Minnesota			New Jersey		
Number of events	Number of elderly	Frequency (%)	Cumulative Frequency (%)	Number of elderly	Frequency (%)	Cumulative Frequency (%)
During 36 months following nursing home admission						
None	5,383	55.6	55.6	4,228	43.9	43.9
1	2,178	22.5	78.1	2,248	23.4	67.3
2	1,059	10.9	89.1	1,310	13.6	80.9
3	504	5.2	94.3	755	7.9	88.8
4	251	2.6	96.9	446	4.6	93.4
5	126	1.3	98.2	223	2.3	95.7
6-10	155	1.6	99.8	352	3.7	99.4
11 or more	21	0.2	100.0	57	0.6	100.0
Maximum # stays	*22*			*18*		
During 12 months prior to nursing home admission						
0	5,213	53.9	53.9	4,845	50.4	50.4
1	2,556	26.4	80.3	2,677	27.8	78.2
2	1,070	11.1	91.3	1,134	11.8	90.0
3	457	4.7	96.1	507	5.3	95.2
4	198	2.1	98.1	222	2.3	97.5
5	97	1.0	99.1	129	1.3	98.9
6-10	79	0.8	99.9	103	1.1	99.9
11 or more	7	0.1	100.0	5	0.0	100.0
Maximum # stays	*22*			*16*		

Table B-7 shows frequencies of specialty hospitalizations (admissions in rehabilitation, long-term acute care, and psychiatric facilities) before and after nursing home entry. These facilities are very few in number, compared to acute care hospitals and SNFs, and are treated separately in our study because of the different case mix

associated with specialty hospitals. For example, these stays often follow acute hospital stays, and compared to acute stays they are longer and oriented more toward physical rehabilitation (or psychiatric assistance, in the case of psychiatric facilities) (MedPAC 2006). Our tabulations of the 1999 Provider of Service file indicate that in Minnesota there were 11 rehabilitation, 3 long-term acute care, and 27 psychiatric facilities in operation in 1999, compared with 137 acute care hospitals and 426 SNFs in the state. Similarly, in New Jersey there were 14 rehabilitation, 3 long-term acute care, and 54 psychiatric facilities in operation, compared with 86 acute care hospitals and 350 SNFs in that year.

As expected, specialty hospital stays are infrequent events relative to acute hospital stays and SNF stays. Table B-7 indicates that about 3% of each cohort is admitted to a special facility after nursing home admission. The bottom panel of the table indicates that there is more utilization of these facilities prior to nursing home entry in the New Jersey cohort— almost 5% used these facilities in the 12 months prior, compared with 1% in the Minnesota cohort.

Table B-7. Frequencies of Medicare specialty hospitalizations before and after nursing home admission

	Minnesota			New Jersey		
Number of events	Number of elderly	Frequency (%)	Cumulative Frequency (%)	Number of elderly	Frequency (%)	Cumulative Frequency (%)
During 36 months following nursing home admission						
0	9,422	97.4	97.4	9,390	97.6	97.6
1	193	2.0	99.4	182	1.9	99.5
2	40	0.4	99.8	35	0.4	99.8
3 or more	22	0.2	100.0	15	0.2	100.0
Maximum # stays	*8*			*7*		
During 12 months prior to nursing home admission						
0	9,563	98.8	98.8	9,273	96.4	96.4
1	93	1.0	99.8	299	3.1	99.5
2 or more	21	0.2	100.0	50	0.5	100.0
Maximum # stays	*4*			*4*		

Table B-8 shows frequencies of SNF stays before and after admission. A slightly larger percentage of the New Jersey cohort was never admitted to SNFs following nursing home admission (MN: 62%; NJ: 64%). Similarly, a slightly larger share of the New Jersey cohort was never admitted to SNFs prior to nursing home admission.

Table B-8. Frequencies of Medicare skilled nursing facility stays before and after nursing home admission

	Minnesota			New Jersey		
Number of events	Number of elderly	Frequency (%)	Cumulative Frequency (%)	Number of elderly	Frequency (%)	Cumulative Frequency (%)
During 36 months following nursing home admission						
0	5,978	61.8	61.8	6,155	64.0	64.0
1	2,096	21.7	83.4	1,883	19.6	83.5
2	918	9.5	92.9	867	9.0	92.6
3-5	622	6.4	99.4	633	6.5	99.1
6 or more	63	0.6	100.0	84	0.9	100.0
Maximum # stays	*12*			*12*		
During 12 months prior to nursing home admission						
0	7,951	82.2	82.2	8,214	85.4	85.4
1	1,237	12.8	95.0	1,032	10.7	96.1
2	363	3.8	98.7	272	2.8	98.9
3 or more	126	1.3	100.0	104	1.0	100.0
Maximum # stays	*7*			*7*		

The next two tables identify the top 10 acute hospital diagnoses in terms of frequency of hospitalizations and size of Medicare payments, during the 36 months after admission (Table B-9) and the 12 months prior to admission (Table B-10). The diagnoses and their order are fairly similar across states and in terms of occurrence before or after admission. On both tables, leading diagnoses include pneumonia, pneumonitis, heart failure, hip fracture, dehydration, septicemia, acute myocardial infarction, chronic bronchitis, and general symptoms.

Table B-9. Top 10 hospital diagnoses during 36 months after nursing home admission

Minnesota			*New Jersey*		
Ranked by number of acute care hospitalizations					
Hospital Admissions (No.)	Description	ICD-9-CM Code	Hospital Admissions (No.)	Description	ICD-9-CM Code
832	Pneumonia, organism unspecified	486.xx	1070	Pneumonia, organism unspecified	486.xx
608	Fracture of neck of femur	820.xx	918	Heart failure	428.xx
535	Heart failure	428.xx	837	Septicemia	38.xx
284	Pneumonitis due to solids/liquids	507.xx	673	Pneumonitis due to solids and liquids	507.xx
279	Disorders of fluid, electrolyte, acid-base balance (dehydration)	276.xx	567	Other disorders of urethra and urinary tract (UTI)	599.xx
249	Acute myocardial infarction	410.xx	559	Disorders of fluid, electrolyte, and acid-base balance (Dehydration)	276.xx
218	Other disorder of urethra and urinary tract (UTI)	599.xx	509	Fracture of neck of femur	820.xx
209	General symptoms (syncope and collapse, seizures)	780.xx	412	General symptoms (syncope and collapse, seizures)	780.xx
189	Septicemia	38.xx	355	Acute myocardial infarction	410.xx
183	Chronic bronchitis	491.xx	311	Other diseases of lung (acute respiratory failure)	518.xx
Ranked by Medicare acute hospital payments					
Medicare Payments ($1000)	Description	ICD-9-CM Code	Medicare Payments ($1000)	Description	ICD-9-CM Code
4416	Fracture of neck of femur	820.xx	9485	Septicemia	38.xx
3585	Pneumonia, organism unspecified	486.xx	7980	Pneumonitis due to solids and liquids	507.xx
2432	Pneumonitis due to solids/liquids	507.xx	7444	Pneumonia, organism unspecified	486.xx
2360	Heart failure	428.xx	6797	Heart failure	428.xx
1826	Acute myocardial infarction	410.xx	6065	Other diseases of lung (acute respiratory failure)	518.xx
1333	Surgical/medical complications NEC	996.xx	4561	Fracture of neck of femur	820.xx
1324	Septicemia	38.xx	3701	Acute myocardial infarction	410.xx
1258	Other diseases of lung (ccute respiratory failure)	518.xx	2843	Disorders of fluid, electrolyte, and acid-base balance (Dehydration)	276.xx
934	Disorders of fluid, electrolyte, acid-base balance (dehydration)	276.xx	2673	Other disorders of urethra and urinary tract (UTI)	599.xx
867	Intestinal obstruction w/o mention of hernia	560.xx	2377	Cardiac dysrhythmias	427.xx

Table B-10. Top 10 hospital diagnoses during 12 months prior to nursing home admission

Minnesota			*New Jersey*		
Ranked by number of acute care hospitalizations					
Hospital Admissions (No.)	Description	ICD-9-CM Code	Hospital Admissions (No.)	Description	ICD-9-CM Code
499	Heart failure	428.xx	607	Heart failure	428.xx
384	Pneumonia, organism unspecified	486.xx	376	Pneumonia, organism unspecified	486.xx
303	General symptoms (syncope and collapse, seizures)	780.xx	363	General symptoms (syncope and collapse, seizures)	780.xx
280	Disorders of fluid, electrolyte, and acid-base balance (Dehydration)	276.xx	361	Fracture of neck of femur	820.xx
236	Fracture of neck of femur	820.xx	348	Disorders of fluid, electrolyte, and acid-base balance (dehydration)	276.xx
215	Cardiac dysrhythmias	427.xx	277	Chronic bronchitis	491.xx
209	Other cerebral degenerations (Alzheimer's Disease)	331.xx	275	Occlusion of cerebral arteries	434.xx
189	Chronic bronchitis	491.xx	252	Other cerebral degenerations (Alzheimer's Disease)	331.xx
187	Acute myocardial infarction	410.xx	224	Cardiac dysrhythmias	427.xx
173	Other disorders of urethra and urinary tract (UTI)	599.xx	210	Other disorders of urethra and urinary tract (UTI)	599.xx
Ranked by Medicare acute hospital payments					
Medicare Payments ($1000)	Description	ICD-9-CM Code	Medicare Payments ($1000)	Description	ICD-9-CM Code
2126	Heart failure	428.xx	3729	Heart failure	428.xx
1617	Fracture of neck of femur	820.xx	3348	Fracture of neck of femur	820.xx
1589	Pneumonia, organism unspecified	486.xx	2519	Acute myocardial infarction	410.xx
1568	Acute myocardial infarction	410.xx	2445	Other diseases of lung (acute respiratory failure)	518.xx
1411	Care involving use of rehabilitation procedures	V57.xx	2407	Pneumonia, organism unspecified	486.xx
1107	Cardiac dysrhythmias	427.xx	2384	Septicemia	38.xx
1061	Other cerebral degenerations (Alzheimer's Disease)	331.xx	2207	Occlusion of cerebral arteries	434.xx
891	Episodic mood disorders	296.xx	1981	Other forms of chronic ischemic heart disease (coronary artery disease)	414.xx
871	Other forms of chronic ischemic heart disease (coronary artery disease)	414.xx	1804	Chronic bronchitis	491.xx
803	General symptoms (syncope and collapse, seizures)	780.xx	1742	Disorders of fluid, electrolyte, and acid-base balance (dehydration)	276.xx

5. Independent Variables: Construction and Descriptive Statistics

Table B-11 summarizes the independent variables used in the analyses. Patient-level variables include race (white, black, other); age (collapsed into 5-year increments); sex; Medicaid status; and three aspects of health: comorbidity, functional, and cognitive status. All variables were measured at nursing home admission and the latter two were also measured at their last nursing home record in the study period, to capture change in functional and cognitive status.

Table B-11. Independent variables

Individual Characteristics:

- Race
- Sex
- Age (at admission)
- Medicaid status (at admission)
- Barthel Index score of physical functioning (at admission and at last assessment in study period)
- Charlson Index score of comorbidity (at admission)
- Cognitive Performance Scale (CPS) score (at admission and at last assessment in study period)

Facility Characteristics:

- Profit status
- Size (number of beds)

County Characteristics (of cohort members' residences):

- Median income
- HMO penetration rate
- Population size (urban-rural continuum)

Given our review of the literature on comorbidity indices (in Maxwell et al, 2004), we constructed a weighted comorbidity index variable using the Deyo adaptation of the Charlson index. The index is a weighted count of 12 comorbidities identified in diagnosis codes from hospital claims from the 12 months prior to nursing home admission. The comorbidities included in the index are: myocardial infarction, peripheral vascular disease, cerebrovascular disease, chronic obstructive pulmonary disease, dementia, diabetes, liver disease, ulcer, rheumatoid arthritis, paralysis, renal failure and HIV/AIDS. Added weights are given to renal failure, sequelae of diabetes, severe liver disease and HIV/AIDS.

Index scores among our cohorts ranged from zero to 12, with lower scores indicating fewer and less severe comorbidities. After conducting univariate analyses to examine the natural breaks in the Charlson score data on the two cohorts, we collapsed the scores for analytic purposes into five groups (index scores of 0; 1; 2; 3; and 4 or

higher). For this variable and those described below, we examined the two cohorts' distributions on a variable separately, and chose a single set of breaks to apply to both cohorts for that variable

To measure physical functioning we selected the Barthel Index. This index was constructed from activities of daily living information on the MDS patient assessment records. Barthel scores in our data range from zero to 90, with higher scores indicating fewer limitations. After examining the natural breaks in the Barthel index scores among the cohorts, we collapsed the data into scores of 0-20; 21-40; 41-60; 61-80; and 81-90. We used Barthel scores at admission in the bivariate analyses (e.g., examining an outcome over time by Barthel score), and used scores at admission and change in scores over time in the multivariate analyses.

To measure cognitive functioning we selected the Cognitive Performance Scale (CPS). The index was derived from cognitive functioning information on the MDS. CPS scores range from zero to six, with lower scores indicating fewer limitations. After examining the CPS data among the cohorts, we collapsed the scores into groups (0; 1-2; 3-4; and 5-6). As with the Barthel information, we used CPS scores at admission in the bivariate analyses and used scores at admission and change in scores over time in the multivariate analyses.

Other independent variables used in the analyses include facility profit status (government-owned, for-profit, non-profit) and facility size, which were derived from the Provider of Service file. After univariate analysis of facility number of beds, we collapsed this information into five groups (0-60; 61-120; 121-180; 181-240; and 241 or more beds).

Two county-level area variables were constructed from the Area Resource File, using cohort members' county of residence: county median income (under $35,000; $35,000-$39,000; $40,000-$44,999; and $45,000 or greater) and a six-level categorization of urban influence. The urban influence code, developed in 1993 by the USDA, distinguishes between counties in large and small metropolitan areas, and distinguishes between "micropolitan" counties that are adjacent or not adjacent to larger metropolitan areas (USDA 2004). The six levels are: 1) county in "large" (greater than 1,000,000 population) metropolitan area; 2) county in a "small" (250,000 to 1,000,000 population) metropolitan area; 3) county adjacent to large metropolitan area; 4) county adjacent to small metropolitan area; 5) "micropolitan" county (county with an urban cluster greater than 10,000 population) not adjacent to metropolitan area; and 6) a rural (non-core) county.

InterStudy data were used to identify county-level HMO penetration. These data were collapsed into three groups: less than 25% HMO penetration in a county; 25% to 39% HMO penetration; and 40% or higher penetration.

Descriptive statistics on the independent variables for the two cohorts are shown in Table B-12. Compared to New Jersey, the Minnesota cohort was predominately white

(97% MN; 89% NJ) and was somewhat older (about 70% in Minnesota were over age 79 compared in 60% in New Jersey). The cohorts were very similar in terms of gender (about 66% female); dual-eligibility (about 15% dually-eligible); and Barthel score at admission (about 40% scored 40 or less). The cohorts were slightly less similar in terms of their Charlson score— overall, the Minnesota cohort had lower comorbidity scores. A larger difference is seen regarding the level of cognitive performance. The Minnesota cohort was more impaired (higher CPS scores) at admission, which is consistent with the higher participation rates of less-impaired elderly in HBCS programs in Minnesota.

Table B-12. Descriptive statistics of independent variables

Variable	Percent	
	Minnesota Cohort	New Jersey Cohort
Individual Characteristics		
Race - White	97.0	88.7
Race - Black	1.3	8.6
Race - Other	1.7	2.7
Age - 65-69	4.5	8.9
Age - 70-74	8.6	11.7
Age - 75-79	16.3	18.3
Age - 80-84	24.7	23.2
Age - 85-89	24.9	21.6
Age - 90-94	15.7	12.5
Age - 95 or older	5.3	3.8
Sex - Female	65.9	66.8
Sex - Male	34.1	33.2
Dual-Eligible (at admission)	14.2	15.9
Barthel Index score (at admission) - 0-20	15.2	20.4
Barthel Index score (at admission) - 21-40	24.7	21.3
Barthel Index score (at admission) - 41-60	23.2	24.1
Barthel Index score (at admission) - 61-80	24.4	21.1
Barthel Index score (at admission) - 81-90	12.6	13.1
Charlson Index score (at admission) - 0	68.6	65.3
Charlson Index score (at admission) - 1	14.6	14.4
Charlson Index score (at admission) - 2	9.6	11.0
Charlson Index score (at admission) - 3	4.3	5.3
Charlson Index score (at admission) - 4 or higher	2.9	3.9
Cognitive Performance Scale score (at admission) - 0	25.1	34.3
Cognitive Performance Scale score (at admission) - 1-2	33.4	29.2
Cognitive Performance Scale score (at admission) - 3-4	33.0	26.4
Cognitive Performance Scale score (at admission) - 5-6	8.6	10.1
Barthel Index score (last record) - 0-20	32.1	34.1
Barthel Index score (last record) - 21-40	23.0	20.1
Barthel Index score (last record) - 41-60	17.8	20.7
Barthel Index score (last record) - 61-80	18.1	15.9
Barthel Index score (last record) - 81-90	8.9	9.2
Cognitive Performance Scale score (last record) - 0	21.3	31.8
Cognitive Performance Scale score (last record) - 1-2	27.6	23.7
Cognitive Performance Scale score (last record) - 3-4	33.7	27.4
Cognitive Performance Scale score (last record) - 5-6	17.4	17.1

Table B-12. (continued) Descriptive statistics of independent variables

Variable	Percent	
	Minnesota Cohort	New Jersey Cohort
Facility Characteristics		
Government-Owned	9.2	6.0
For-Profit	29.9	65.6
Non-Profit	60.8	28.4
Size - 0-60 beds	10.0	11.0
Size - 61-120 beds	41.7	27.0
Size - 121-180 beds	25.8	30.8
Size - 181-240 beds	11.7	17.4
Size - 241 or more beds	10.9	13.8
Area Characteristics		
Median County Income - under $35,000	5.7	1.4
Median County Income - $35,000 - $40,000	25.7	6.5
Median County Income - $40,000 - $45,000	11.5	15.1
Median County Income - greater than $45,000	57.0	77.1
County HMO Penetration - less than 25%	43.7	21.9
County HMO Penetration - 25% - 40%	40.2	76.4
County HMO Penetration - greater than 40%	16.1	1.7
Large Metropolitan County	51.9	84.3
Small Metropolitan County	12.1	15.7
Adjacent to Large Metropolitan County	5.5	0.0
Adjacent to Small Metropolitan County	12.0	0.0
Micropolitan County	9.0	0.0
Rural County	9.5	0.0

Table B-12 also describes the facility and area characteristics of the cohorts. The Minnesota cohort predominately entered non-profit nursing homes (61%) and smaller nursing homes (52% in facilities with 120 or fewer beds), while the New Jersey cohort was more concentrated in for-profit facilities (66%) and larger ones (only 38% in facilities with 120 or fewer beds). The Minnesota cohort members reside in counties with lower median county income (about 30% in counties with median income less than $40,000 compared with 8% in New Jersey— although the impact of this is somewhat less because these county income figures are not adjusted for cost of living); lower HMO penetration (44% in counties with low penetration compared with 22% in New Jersey); and lower population density (about 50% in large metro counties compared with 84% in New Jersey).

6. Bivariate Analyses

To identify and visualize trends in the data, we conducted tabulations of the outcomes in 30-day increments, stratified by the person-level and area-level characteristics. For each cohort, we first examined survival rates at each 30-day

increment (defined as the percent of the original cohort members alive in a given study month). We then examined Medicaid enrollment using two population bases: 1) Medicaid enrollment in each 30-day period as a percentage of survivors in each 30-day increment; and 2) Medicaid enrollment in each 30-day period as a percentage of the original cohort population. We then examined, in 30-day increments, the percentage of the original cohort who had incurred any acute hospital stay since their nursing home admission. Finally, we examined the 36-month totals of health care spending per original cohort member, by type of service (Medicare acute hospital, specialty hospital, and SNF spending; and Medicaid nursing home, prescription drug, and other Medicaid spending).

Each outcome was stratified by individuals' demographic characteristics (sex, race, age); health status (Charlson score, Barthel score, CPS score); their nursing home characteristics (number of beds, profit status); and their area characteristics (median county income, urban influence, and HMO penetration). The variables that were continuous in their original form were collapsed into categories, as described earlier.

7. Multivariate Analyses

To assess the relative influence of these characteristics on the outcomes, we explored and developed several multivariate models of the following outcomes: death; discharge to a lower level of care; Medicaid enrollment; hospitalization following NF admission; SNF use following NF admission; hospitalization use and spending prior to NF admission; and SNF use prior to NF admission. The models account for the characteristics described above, including overall time exposure (i.e., resulting from death or NF discharge) over the 36-month observation period. Models were developed separately for each state cohort, and the state effects on both the intercepts and coefficient groups were then tested.

a. Utilization and Spending Before and After NF Admission

Spending and utilization after nursing home admission was modeled using two-part models, assuming a Poisson distribution to estimate frequency and intensity of service use. A main advantage of Poisson models over the logit specification often used in two-part models (Duan et al. 1983) is that they take advantage of variation in the number of utilization events and exposure period to estimate the relative risks of incidence experienced by beneficiaries. These Poisson models are expressed in the following form:

$$P(U_i = y_i) = \frac{e^{-\lambda_i}\lambda_i^{y_i}}{y_i!}, \quad y_i = 0, 1, 2... \text{ where } \ln\lambda_i = \boldsymbol{\beta}' X_i \qquad (1)$$

For the utilization events that occur prior to admission (since exposure time does not vary), and the spending-related event that is expected to occur only once after admission (Medicaid enrollment) we used the standard logit model. These models are expressed in the following form:

$$P(U_{ji} > 0) = \frac{\exp(\alpha_j + X_i'\beta_j)}{1 + \exp(\alpha_j + X_i'\beta_j)} \quad (2)$$

The second part of the expenditure models is a simple linear regression using the natural log of expenditure as the dependent variable and the subset of observations with any spending over the three years after (or one year prior) as the sample. These models are of the form:

$$\ln(U_i) = X_i'\delta + \varepsilon_i \quad if \quad U_i > 0 \quad (3)$$

b. Event Outcomes

We used survival analysis techniques to estimate the timing of certain event outcomes. We estimated the parameters of a continuous time hazard function of the following form:

$$h\ (t; X_{it}) = \lim_{\Delta \to 0+} \frac{\Pr(t < T_i \le t + \Delta \mid T_i \ge t, X_{it})}{\Delta} \quad (4)$$

where $h\ (t; X_{it})$ represents the instantaneous probability that person *i* will experience a "failure" (e.g., a Medicare hospitalization) at time *t* given that she has survived without a failure before *t*, and given individual characteristics at time *t*, X_{it}. Maximum likelihood estimation techniques were used to estimate the parameters of the function. Estimation of the hazard function requires the specification of a functional form to explain how the hazard varies with time and explanatory variables. We specified the hazard as proportional to a baseline hazard. Thus,

$$h(t; X_i) = h_0(t) g(X_{it}). \quad (5)$$

We used the Cox model and make no further assumption about the specification of the baseline hazard, $h_0(t)$.

The effect of the covariates is to multiplicatively shift the baseline hazard up or down, respectively reducing or prolonging the expected time to failure, and is often parameterized as

$$g(X_{it}) = \exp(X_{it}'\beta). \quad (5)$$

The data element necessary for estimating these models was the elapsed time between the date of nursing home admission and the date of the outcome being analyzed. One complication is that we did not observe a time to all outcomes for all members of the state cohorts. For example, a small percentage of the cohorts (about 5% and 8% for Minnesota and New Jersey, respectively) were not hospitalized at all during the observation period. As is typical in hazard models, death or the end of the observation period are treated as "competing" failure types. The problem of competing risk is often summarized as the estimation of the risk of certain types of failure given the absence of some or all other failure types.

Despite the analytic and resource burdens imposed by using these methods, they provide more accurate estimates of the outcomes in question. It is important to jointly account for mortality, Medicaid enrollment, and Medicare utilization when analyzing events and spending patterns in this study population, which has a high mortality risk and high Medicaid enrollment risk, due to age and the health and functional limitations that result in nursing home admission.

Logistic regression methods, which are much more commonly used, are not capable of jointly accounting for censorship and utilization. For example, if logistic methods were used, we would produce under-estimates of aggregate probability of nursing home use, and we could not ascertain why a cohort member is not entering a nursing home (because of death or because of no need for institutional care).

c. Conceptualizing the Independent Variables

Using the terminology of Anderson's (1995) model of health care utilization, a range of predisposing, need, and enabling characteristics potentially influence the outcomes modeled on the NF cohorts. Predisposing factors include demographic, social structure, and belief characteristics. Need factors are the most direct, and refer to health status or medical condition. Enabling factors include economic and policy factors that combine to determine whether services are available and affordable. Individual-level factors like income, wealth, and insurance coverage affect affordability and demand. Area-level factors affect price and supply, while Federal, state, and local policy can affect both the demand and supply.

The predisposing characteristics available in the data and controlled for in the models include, as discussed above, age, sex, and race. Availability of family support is a particularly important factor in studies of long term care that could not be controlled for either directly or by proxy in this study. Other predisposing factors not available in the data have explanatory and policy importance primarily because of their association with other, more direct factors. Thus the significance of their omission often can be reduced in quantitative analyses by stringently controlling for available need and enabling factors.

We control for need primarily through the use of the three health status factors we described above (Charlson index, Barthel index, CPS score) and change in two of these

(Barthel, CPS). We also control for need by accounting for health care utilization (a proxy for need) prior to nursing home admission.

Income has been shown to be an influential enabling factor. We attempt a proxy for this by using information on county-level median incomes.[3] Other enabling factors we account for include nursing home facility characteristics (size, profit status); area urban influence; area HMO penetration; and state nursing home regulations as reflected by a state variable.

C. Findings of Bivariate and Multivariate Analyses

The bivariate findings are presented in the form of a Chart Book, located in the Appendix. As seen in the Chart Book, five outcomes over the 36-month observation period are illustrated for each state cohort, and are located in the following order:

- survival rates (i.e., survivors at each 30-day increment as a percentage of the original cohort members): Figures A1-A22;
- Medicaid enrollment rates among survivors (i.e., Medicaid enrollment in each 30-day increment as a percentage of survivors in each 30-day increment): Figures A23-A44;
- Medicaid enrollment rates among the original cohort population (i.e., Medicaid enrollment at each 30-increment as a percentage of the original cohort population): Figures A45-A66;
- hospitalization rates (i.e., the percentage of the original cohort who have incurred any acute hospital stay since nursing home entry): Figures A67-A88; and
- total study period (i.e., 36-month) spending per member of the original cohort, by six service types (Medicare spending for acute hospital, specialty hospital, and SNF care; Medicaid spending for nursing home care, prescription drugs, and all other services): Figures A89-A108.

In the Chart Book, each outcome is stratified by 11 characteristics, and are located in the following order:

- individuals' demographic characteristics (sex, race, age category);
- health status (Charlson score category, Barthel score category, CPS score category);

[3] Since Medicare administrative data do not contain information on individual socioeconomic status, neighborhood characteristics will be used as proxies. Inferences based on these variables should account for clustering effects in calculations of standard errors.

- nursing home characteristics (number of beds category, profit status); and

- area characteristics (median county income category, urban influence category, and HMO penetration category).

We restrict our discussion of the outcomes and characteristics to the multivariate findings below, wherein these factors are simultaneously controlled.

1. Events Following Nursing Home Admission

a. Mortality

Our multivariate (Cox proportional hazard) models of mortality risk among newly admitted residents of nursing homes, presented in Table C-1, find that the individual level factors—age, race, sex, and health status—are statistically significant predictors of mortality. In both the Minnesota and New Jersey cohorts, black beneficiaries have substantially lower mortality risks (measured by the *hazard rate ratio*) than whites, other factors being equal. Not surprisingly, mortality risks increase greatly with age, are larger for males than for females, and increase with worse health status (lower Barthel scores, and higher Charlson scores). Higher levels of cognitive impairment as measured by the CPS are associated with lower mortality risk. Medicaid enrollment is associated with lower mortality risk, but the effect is only significant in New Jersey. One possible explanation for this difference is related to the stricter income eligibility standards in New Jersey, making the average Medicaid enrollee in that state of much lower income. Thus Medicaid eligibility may simply be a proxy for individual income, for which we have no direct measure in our data.

Facility and area-level factors are less likely to significantly affect mortality risks. Persons residing in a for-profit facility have higher mortality risk than those residing in government facilities, but there are no significant differences associated with facility size. In Minnesota, risks may be higher in the highest income areas (counties with median income over $45,000) and in areas with higher HMO penetration rates. There also appears to be some difference in mortality along the urban/rural continuum. These area differences are largely absent in New Jersey.[4]

b. Hospitalization

Table C-2 presents the model of hospitalization risk during the stay in the original nursing facility. (We also analyze hospitalization risk over the entire three-year follow-up period when we discuss our findings on spending below.) In neither state do we find significant differences in hospitalization risk between whites and blacks, though other non-whites in Minnesota appear to have substantially (40%) higher risks than whites,

[4] Note that New Jersey has no non-metropolitan areas. Effect of "Large Metropolitan" county is relative to the 5 counties classified as either "Small Metropolitan" or "Adjacent to Large Metropolitan" counties.

while no such difference is found in New Jersey. We find a reduced risk of hospitalization with advanced age in Minnesota, but not in New Jersey, where there is no consistent or statistically significant pattern. In Minnesota, persons over 95 are approximately 3/4ths as likely as those 65-70 to be hospitalized while a resident of the nursing facility. Men are approximately 33% more likely than women to be hospitalized in both states. In New Jersey, persons who had been Medicaid enrollees prior to NF admission were 6% more likely than non-Medicaid users to be hospitalized while residing in the NF, and residents also experienced an elevated risk of hospitalization after they qualified for Medicaid benefits. In Minnesota, however, we found no effect of prior Medicaid enrollment, and a statistically significant 14% reduction in the risk of hospitalization after the resident qualified for Medicaid. Residents with greater ADL independence face lower risks of hospitalization in both states. Those in the most independent category (Barthel scores above 80) are half as likely as those in the most dependent category (scores 20 and under) to be hospitalized while a resident of the NF. Those with more comorbidities (as measured by the Charlson index score) had significantly higher risk of hospitalization. Those with scores of 4 or more were twice as likely to be hospitalized as those with no comorbid conditions diagnosed in the prior year. Finally, in both states, those with higher levels of cognitive performance (lower CPS values) were the least likely to be hospitalized. The CPS gradient in Minnesota was strongest on this measure: those with CPS values of 5 or 6 had only 40% of the hospitalization risk of those with no cognitive limitation. In New Jersey, the same relative risk was nearly 70%.

At the facility level, persons residing in private facilities were more likely to be hospitalized than those in public facilities in both states. Facility size mattered only in Minnesota, however, where those in the largest nursing homes (240 beds or more) had 85% of the hospitalization risk of those living in the smallest facilities. Few area-level effects were found, although county income appeared to be inconsistent with the highest income counties being associated with highest hospitalization risks in Minnesota, but only second highest in New Jersey. We found no significant effect of managed care penetration in either state.

c. Medicaid Enrollment

The hazard models of first Medicaid enrollment (sample is limited to persons not previously enrolled), are presented in Table C-3. In these models, the only competing risks are death and right-censorship. Thus, Medicaid conversion can be observed either during the NF stay or after discharge. The most dramatic finding is that persons in Minnesota qualify for Medicaid more quickly (relative hazard of 10.7) than persons in New Jersey. This likely reflects the more generous income eligibility standards in Minnesota. The relatively less selective nature of Medicaid eligibility in Minnesota may also explain why few other factors have a significant association with Medicaid enrollment.

In both states, higher levels of cognitive impairment are strongly related to faster Medicaid conversion. Controlling for other factors, the severely cognitively impaired tend to live longer (Table C-1) and are least likely to be discharged (Table C-4). Thus they spend longer periods receiving high-cost care than those with little cognitive

impairment, and are more likely to spend-down assets and become Medicaid eligible. High HMO penetration and non-rural counties are also associated with higher rates of Medicaid use. In New Jersey, individual factors are more strongly related to Medicaid use among NF residents. Older persons, women and non-whites are more likely to enroll in Medicaid, as are persons with greater physical independence (Barthel) and greater cognitive impairment (CPS). Those residing in government facilities and in larger facilities also have elevated Medicaid risks.

d. Nursing Home Discharge

To understand factors that are associated with longer and shorter stays in nursing facilities, we estimated models of discharge from the nursing facility to lower levels of care (either home or assisted living). Results are shown in Table C-4. We find that white residents, older persons, and those who are on Medicaid are least likely to be discharged to these settings. We find a strong association with health and functional status. Not surprisingly, those with higher degrees of cognitive and physical limitations are less likely to be discharged to lower intensity care. Those living in non-government facilities are most likely to be discharged. In New Jersey, larger facilities are associated with lower discharge risk, while the opposite is true in Minnesota. Discharge is more likely for those living in higher-income counties.

We also estimated separate models for assisted living and home discharges (Tables C-4a and C-4b). While results are largely consistent (e.g., cognitive performance scores are highly significant predictors of each type of discharge), the magnitudes and significance levels on coefficients vary between settings. For example, the race/ethnicity differences are significant for ALF discharges but not for home discharges. In New Jersey, the Charlson index score is a more significant predictor of ALF discharge than home discharge. Also in New Jersey, the strong facility ownership findings are driven mostly by the differences in ALF discharges, as the home discharge differences are insignificant. To some extent, these differences in New Jersey are likely driven by the relative infrequency of home discharges, as fewer such events will result in more variability in coefficient estimates.

The lack of significant state effects in the two discharge models suggest that the raw differences in discharge rates in New Jersey and Minnesota (Table B-5) are related to observed covariates. A likely contributor to these differences is the high level of urban influence in New Jersey. While there is not a "rural" county in New Jersey, the persons living in rural counties in Minnesota are significantly less likely to be discharged to an assisted living facility. In addition, African Americans in both states have higher probabilities of being discharged to AL facilities, and there is a substantially higher fraction of the New Jersey cohort who are African American.

2. Medicare and Medicaid Spending

Our models of spending and utilization are two-part models. For hospital and SNF utilization, we first estimate a Poisson regression model. This model generates an

incidence rate ratio for the independent variables, controlling for the period of exposure for each individual. Among those with any utilization, we then estimate a log-linear model of spending that allows us to compare relative rates of spending over the period of observation. To describe patterns of Medicaid costs we first estimate logit models of (any) Medicaid payments and then log-linear models of those payments for cohort members who have any.

a. Medicare Acute Hospital Stays

Not surprisingly, we find that demographic and health factors are very strong predictors of hospitalization among nursing home residents. However, we find somewhat different effects in the two states we study. In both Minnesota and New Jersey, over the three years following admission, Table C-5 indicates that blacks have higher incidence rates of hospitalization following nursing home admission than whites. But while other non-whites have the highest rates of hospitalization in Minnesota, they have the lowest rates in New Jersey. Similarly, after controlling for survival, the rates of hospitalization appear to increase with age in New Jersey, but they appear to decrease with age in Minnesota. In both states, men are more likely than women to be hospitalized, as are those who were enrolled in Medicaid prior to entering the nursing facility. Not surprisingly, previously diagnosed comorbidities (Charlson) greatly increase the incidence of hospitalization in both states. However, while higher levels of ADL functioning at admission (Barthel) reduce the rate of hospital use in New Jersey, there is no consistent effect of this measure in Minnesota.

CPS at admission has opposite effects in the two states, with lower performance associated with more hospitalization in New Jersey and less hospitalization in Minnesota. When we measure the effect of changes in function over the period, we find that persons who improve in ADL functioning have lower incidence of hospital use in both states, though it is only statistically significant in New Jersey. Similar to our findings on their levels, changes in cognitive assessments appear to work in opposite directions in the two states. Worsening performance increases hospitalizations in New Jersey but reduces them in Minnesota. In sum, it appears that older and frailer residents receive less aggressive acute medical treatment in Minnesota than in New Jersey.

Facility size appears to have no significant impact on rates of hospitalization, but elderly Medicare beneficiaries residing in private facilities, whether for-profit or non-profit, are more likely to be hospitalized than those in public facilities. Finally, there appears to be little effect of area characteristics on rates of hospital use.

Among persons who are hospitalized, the states appear more similar in their determinants of relative spending. Most noticeably the intensity of spending falls with age in both states, though this is partly a function of lower survival probabilities of older beneficiaries. Black beneficiaries have 15% (NJ) to 22% (MN) higher spending than whites, and other non-whites have higher spending than whites in Minnesota, but not in New Jersey. Men have higher expenditures than women, though the 12% difference is only significant in New Jersey. In New Jersey, beneficiaries who had been Medicaid enrollees prior to NF admission had 11% higher expenditures than those who had not, but

there was no significant difference in Minnesota. On measures of health and functional status, the two states show very similar patterns. There is very little direct relationship between ADL function (Barthel) and spending intensity in either state. Comorbidities have a strong positive effect on spending intensity in both states, and higher cognitive performance is associated with higher intensity spending in both states as well. Improvements in ADL function reduce spending in New Jersey, but have a weak positive association with spending in Minnesota.

At the facility level, residents of for-profit facilities have significantly (22%) higher spending than public facilities in New Jersey, but there is no significant relationship between ownership and spending in Minnesota. Spending by residents of private non-profit facilities is not significantly different from that of persons residing in public facilities in either state. At the area level, higher county income significantly increases spending intensity in Minnesota, but not in New Jersey, while higher managed care penetration reduces spending intensity in New Jersey but not in Minnesota. Spending in New Jersey counties with greater than 40% managed care participation is 25% lower than in counties with less than 25% participation. Finally, spending intensity tends to be higher in the more urbanized areas of both states.

b. Medicare Skilled Nursing Facility Stays

Table C-6 presents similar two-part models of SNF stays. Focusing first on the determinants of the number of SNF stays as estimated by the Poisson models, there is no significant difference between whites and black in either state, but other non-whites again show different patterns in the two states. Age patterns of risk differ as well. While increasing age is associated with higher SNF utilization in New Jersey, there is no such pattern in Minnesota. Men have approximately 20% higher incidence of SNF use than women in both states. Higher ADL dependence and higher comorbidity scores are associated with higher risk of SNF use in both states. For cognitive performance, we find different risk profiles in the two states. In New Jersey, those with more cognitive limitations are more likely to use a SNF, while in Minnesota they are significantly less likely to do so. In both states, improvements in ADL function are associated with reduced SNF use while improved CPS is associated with lower SNF use in New Jersey only.

At the facility level, we hypothesized that for-profit (and other private) facilities may have greater incentives to seek Medicare SNF reimbursement. In table C-2 we reported that residents of both types of private facilities faced increased risk of hospitalization. Table C-6 indicates that in Minnesota, the use of the SNF benefit is also higher in these facilities. We find no such effect in New Jersey. Residents of larger facilities in New Jersey appear to have lower rates of SNF use, while in Minnesota, the highest risks are found in medium sized facilities (60-120 and 180-240 beds), while those living in the smallest and largest facilities have lower risks. At the area level, residents of the lowest income counties in New Jersey are 25% less likely to use the SNF benefit than those in the highest income counties, while we find no income gradient in Minnesota. In Minnesota, those living in the most urban counties are the least likely to use SNF care.

There are relatively few factors that significantly affect spending intensity among those who use the SNF benefit. Among the most prominent, high levels of cognitive limitation are associated with less SNF spending in both states. At the facility level, those in for-profit facilities have the highest spending in both states conditional on using the benefit. And at the area level, persons using SNF services in counties with higher managed care penetration have lower levels of spending.

c. Medicaid Nursing Home Benefit

The logit model for using the Medicaid nursing home benefit produces very similar results to the hazard model above, so we will focus our attention on the Medicaid spending models in table C-7. Not surprisingly, many of the results for this analysis appear to be mirror images of the mortality findings in table C-1. The same factors that predict relatively short survival periods after admission also predict higher long term care spending. In New Jersey, the relative Medicaid spending of black beneficiaries over the three years following nursing home admission is higher than that of whites, but the differences in Minnesota are not statistically significant. Spending in New Jersey tends to decline for the very old, perhaps because of lower rates of survival to those ages. Indeed mortality findings in table C-1 show a somewhat stronger age gradient in the mortality hazard for New Jersey than for Minnesota. Also a likely result of differential survival, men have lower levels of Medicaid spending than women. While prior Medicaid enrollment in New Jersey predicts increased spending after nursing home admission, the same is not true in Minnesota. Among clinical factors, higher comorbidity scores are associated with lower Medicaid spending in both states; higher degrees of ADL independence are associated with more Medicaid spending (most strongly seen in New Jersey); and cognitive limitations, which are associated with longer survival are also associated with higher Medicaid spending. Persons living in private facilities tend to spend longer as private-pay residents, and thus their levels of Medicaid spending are lower. Finally, area characteristics have very little impact on Medicaid spending levels.

3. Utilization Prior to Nursing Home Admission

We conducted two analyses of prior utilization for those admitted to nursing facilities in 1999. We estimated a two-part model of hospital admission and spending in the year before admission and a logit model of any SNF use in the three months prior to admission.

a. Medicare Acute Care Hospitalization

Table C-8 presents the results of the hospital analysis. Individual factors were much more "predictive" of hospitalization in New Jersey than in Minnesota. Significant variation was found based on age and health status measured at admission in New Jersey. Older residents and those with more assessed ADL limitations (Barthel) were more likely to have had a hospitalization in the preceding year. In New Jersey, but not Minnesota, those whose ADL functioning improved while they were NF residents were also more

likely to have had a hospitalization in the year leading up to admission. At the facility level, those in for-profit private facilities were less likely to have been hospitalized than those in public facilities, though the difference is only significant in New Jersey.

While the predictors of whether newly admitted NF residents had a hospital stay in the previous year are different in Minnesota and New Jersey, the determinants of the levels of spending are quite similar in the two states. Hospital spending is substantially higher among younger residents, men, those previously on Medicaid, those with lower ADL functioning and fewer cognitive limitations. Those whose cognitive limitations worsened in the nursing facility were lower-intensity users prior to admission as well. The area characteristics that influenced prior hospital spending are not consistent across states, however.

b. Medicare SNF Utilization

We also estimated the probability that new nursing home residents had a SNF stay shortly before admission. As is the case for several other utilization measures, age and race patterns differed between the two states. Men and women, however were equally likely to have had a recent SNF stay in both states. Those with the lowest level of ADL functioning were the most likely to have had a SNF stay, and those with the most severe cognitive limitations—not typically an acute illness that could lead to post-acute care—were the least likely to have had a SNF stay prior to admission. At the facility level, ownership status had little relationship to SNF stays, but those in smallest facilities were the most likely to have had a SNF stay preceding their NF stay in both states. Finally, in Minnesota, residents of urban areas were least likely to have had a SNF stay while in New Jersey, those in the most urbanized counties were the *most* likely to have had a SNF stay.

D. Summary and Discussion of Results

Below, we summarize the event and spending outcomes of the Minnesota and New Jersey cohorts at the 36-month point (calculated using the number of members in the full, original cohorts), and then discuss the results of the bivariate and multivariate analyses across the outcomes studied, noting major commonalities and differences in the results across the outcomes.

1. Outcomes

In each cohort, about 43% survived at least the full study period. Approximately 50% of the original cohort members had enrolled in Medicaid by the 36-month point (MN: 53%; NJ: 50%). Roughly 30% were discharged to lower forms of care. While these overall NF discharge rates are fairly similar (MN: 28%; NJ: 33%), twice as many Minnesota members were discharged from the NF to home (MN: 11%; NJ: 6%), and a larger share of the New Jersey cohort was discharged to assisted living facilities (MN: 17.3%; NJ: 27.4%). The more developed home and community based care system in Minnesota appears to affect initial admissions more than discharges, however. The initial

distribution of cognitive performance scores, for example, indicates that Minnesota's cohort is more selected on severe impairment than New Jersey's cohort. Once in a NF, however, supply and other demographic factors seem to explain the observed discharge patterns.

A substantially smaller share of the Minnesota cohort incurred acute hospital stays (45%) compared to the New Jersey cohort (56%). Unlike the hospitalization rates, SNF admission rates were similar across the two cohorts (about 37%), as were specialty hospitalization rates (about 3%). Since Medicare coverage for a SNF stay requires a prior hospital stay, the cohorts' hospitalization and SNF rates suggest that a much larger share of hospital stays in the Minnesota cohort were followed by SNF stays.

Over the 36-month study period, Medicare Part A spending averaged $8,285 per cohort member and $15,369 per member for the Minnesota and New Jersey cohorts, respectively. Most of the spending difference was driven by acute hospital spending, which was almost twice as high in the New Jersey cohort (MN: $4,974; NJ: $10,958). This is consistent with the finding above, that a higher percentage of the New Jersey cohort was hospitalized. In contrast, however, average SNF spending per member was higher in New Jersey (MN: $2,858; NJ: $4,157), even though the SNF admission rates were similar across the cohorts.

At about $29,000 per cohort member, Medicaid spending was more comparable across the cohorts than Medicare Part A spending. As expected, most of the Medicaid spending was attributable to nursing home payments (about $24,000 per cohort member). Average Medicaid prescription drug spending was about three times higher in the New Jersey cohort (MN: $875; NJ: $2,510), while Medicaid spending other than for NF care and prescription drugs was lower among that cohort (MN: $4,150; NJ: $2,404).

2. Patient characteristics

As expected, patient characteristics were generally more predictive than facility characteristics in the hazard models. In particular, we observed that functional status had the largest influence among the characteristics on mortality. For example, across both states, individuals with few or no functional limitations (Barthel scores of 81-90) had about 1/10th the mortality risk of those with severe limitations (Barthel score of 20 or less), controlling for other characteristics. As the bivariate results in the Chart Book illustrated, in both cohorts at the 36-month point survival ranged from almost 60% (among those with greater independence) to about 25% (among those with less independence).

Comorbidities and functional were key predictors for hospitalization while in the nursing home— across both states, individuals with several comorbidities (a Charlson score of 4 or higher) were about twice as likely to be admitted (when controlling for other characteristics), compared to those with no comorbidities. Those with the fewest functional limitations (Barthel 81-90) were about one-half as likely to be hospitalized as those with the highest level of limitation (Barthel less than 20). The bivariate results

illustrated that at the 36-month point the percent of Minnesota cohort members hospitalized ranged from a low of 36% (among those with no hospital claim prior to NF admission and thus no comorbidities noted) to a high of 62% (among those with a Charlson score of 4 or higher). In New Jersey, those percentages ranged from a low of 45% to a high of 75%.

Controlling for other factors, cognitive status was a key predictor for first Medicaid enrollment, particularly in New Jersey. In that cohort, individuals with severe limitations (CPS scores of 5-6) were almost twice as likely to enroll in Medicaid compared to those with no limitations. In Minnesota, CPS scores of 5-6 were associated with a 37% higher risk of Medicaid enrollment, compared to those with no limitations. Lengths of nursing home stays were longest among cohort members with higher cognitive impairments. Long nursing home stays, and the accompanying depletion of individuals' financial resources, may explain the relationship between CPS score and Medicaid enrollment. As the bivariate results illustrated, among those surviving the entire study period the Medicaid enrollment rate range from a low of 50% in Minnesota (CPS score of 0) to a high 71% (CPS score of 5-6). The difference in enrollment rates by CPS score was greater in New Jersey, and ranged from a low of 32% CPS = 0) to a high of 73% (CPS = 5-6).

In the hazard models, several patient characteristics were statistically significant predictors of discharge to lower care levels, including race (black), lower age, higher functional status, higher cognitive status, and no Medicaid enrollment. The risk gradient was particularly large regarding age, cognitive status, and Medicaid status. These characteristics also were the leading predictors when we modeled the two discharge destinations separately. As discussed further below, however, nursing home profit status was the single largest predictor of this outcome.

Across the four events (mortality, hospitalization, Medicaid enrollment, and discharge) the models were least predictive of Medicaid enrollment, especially regarding Minnesota. In that state, only two characteristics were consistently and significantly associated with enrollment— poorer cognitive status and residing in a non-rural county. In New Jersey, however, several additional characteristics predicted Medicaid enrollment. In particular, older individuals, women, non-whites, and those with greater functional independence but poorer cognitive status were more likely to enroll. Those in government-owned and larger facilities were more likely to enroll also. One possible explanation for this finding is that the relatively generous eligibility standards for spend-down in Minnesota allow a less selective portion of the cohort to qualify for Medicaid benefits. In New Jersey, other factors become important in differentiating those with higher spending and lower income levels.

When comparing the Minnesota hazard models with the New Jersey models across the outcomes, we observed that a fairly similar set of patient characteristics were significant across both states in predicting mortality. The same observation was made regarding the two cohorts and the NF discharge model. In the hospitalization model, however, age is a fairly strong predictor in Minnesota but has no effect in New Jersey.

Our two-part spending models indicate that once individuals were hospitalized, however, the two cohorts were more similar in their determinants of relative Medicare spending. The Medicare hospital spending patterns were fairly similar across demographic characteristics and quite similar in terms of comorbidities and functional status. Again comparing the two states' hazard models, differences in the models were most striking regarding Medicaid enrollment. Cognitive status was the main factor that influenced enrollment in the Minnesota cohort. In contrast, race, age, sex, and functional status also were significant factors in the New Jersey cohort

3. Facility characteristics

Facility characteristics (profit status and bed size) had a larger influence on the risk of NF discharge to lower levels of care, compared to their influence on other outcomes. The effect is very strong in New Jersey, where those in for-profit facilities were almost 4 times more likely to be discharged to lower levels of care than those in government ones, and those in non-profit facilities were 3 times more likely to be discharged. The effect size and gradient was smaller in Minnesota, where individuals were 61% more likely to be discharged to lower levels of care from for-profit facilities than government-owned ones, and 29% more likely to be discharged from non-profits. Facility size had an opposite effect on the two cohorts— in Minnesota, individuals were more likely to be discharged from larger facilities, while in New Jersey they were more likely to be discharged from smaller ones. Across the other outcomes (mortality, hospitalization, and Medicaid enrollment), profit status generally was a significant factor, however its effect size was smaller regarding these outcomes than regarding risk for discharge.

4. Area characteristics

As expected, the county-level characteristics generally had the weakest association with the outcomes, compared with the person-level and facility-level variables. Higher HMO penetration was significantly associated with higher risks for two of the four events— mortality and Medicaid enrollment. The bivariate results indicate that at the 36-month point, the share of individuals alive in each cohort were about 4 percentage points higher in the low penetration areas— about 44% in the lowest penetration counties versus 41% in the highest penetration counties. County-level median income had an effect on all four outcomes, however compared to HMO penetration, the effect size of county income was smaller and the pattern of the effect generally was not monotonic across the income levels, making interpretation of the variable difficult. The effect of urban influence on the outcomes generally was not significant and not monotonic.

E. Comments

This report summarized the development and analysis of a longitudinal study of two state cohorts of elderly entering nursing homes for the first time, in 1999. Forward-looking and backward-looking analyses were conducted. The primary focus was to assess the trajectory of health events and expenditures, Medicaid enrollment, and mortality among the cohorts over a 36-month period. In addition, the course of hospital

and SNF events in the 12 months leading up to entry were assessed as well, to help understand these risks associated with nursing home entry. The cohorts were comprised of 100% of the nursing home entrants in two states, New Jersey and Minnesota, which were selected based on their HCBS participation rates, geographic representation, sample size, and Medicaid data quality.

The study addressed a broad waterfront of outcomes and explanatory factors, many of which are fruitful avenues for further investigation. For example, further analyses of the cohorts' hospitalization experiences would shed light on the differences in health care treatment styles, seen particularly in variation in hospitalization rates, of nursing home residents in Minnesota compared to New Jersey. The state variations found in this study confirm some of the differences seen in studies on the area variation in health care utilization among the general population by Wennberg and others (e.g., Weinstein et al, 2004). This study contributes to subject of geographic variation in health care, however, through its focus of nursing home residents.

Similarly, further analyses of cognitive impairment would be productive for fully understanding its dominance in explaining hospitalization risk and in understanding the opposite impact it sometimes has in predicting outcomes for the two state cohorts. While a review of the published literature suggests that cognitive function is often controlled in clinical studies of specific hospitalized conditions, there are fewer studies assessing broad trends and patterns regarding cognitive function and hospitalization than there are regarding cognitive function and nursing home utilization.

A significant aspect of the study is its analysis of two states, whereas many long-term care studies address one state or rely on national surveys, which typically do not have sufficient sample sizes to compare state experiences. The use of the two states— which were selected for their contrasting profiles in terms of geography, socio-cultural demographics, and use of home and community-based services for individuals who are nursing home eligible— offers insight into the stability of the estimates, or effect size, of the explanatory factors and suggests that caution is needed in some cases when considering cross-state or national generalizability of studies on nursing home users. In many of the multivariate models, several individual, facility, and area factors had opposite effects across the two cohorts or at least significant differences in their effect size. This was particularly the case in the models predicting risks for Medicaid enrollment and hospitalization, and the two-part models predicting hospital use, but examples occurred in each outcome modeled. Factors that frequently behaved differently across states include race (particularly other non-whites), cognitive function, and nursing home profit status.

The breadth of this study affords an examination of the varied impact of person, facility, and area characteristics across a range of health outcomes and across two states. Particularly in this context, it is important in the study design phase to limit estimation error. The statistical methods used and data sets available to this study were key in this regard. For example, by using proportional hazards estimation techniques we were able to account for competing risks when modeling each of the specific outcomes. It is

particularly important to account for competing risks in analyses of any population with a relatively high mortality risk, like nursing home residents. If standard logistic regression is used, in contrast, one would underestimate the aggregate probability of the utilization events studied (hospitalization, SNF use, Medicaid enrollment). Further, the use of Medicare, Medicaid, and nursing home patient assessment data afforded this study a relatively long follow-up period (36 months) and the use of the universe of the available population in the states rather than a population sample. Finally, the data afforded the construction of detailed measures of health, functional, and cognitive status and change in status.

Along with measures of health, functional, and cognitive status, other measures that are fundamental to conceptual models of long-term care— and often pivotal to empirical models— are measures of family and social support. An important limitation of this study is the lack of this information. The availability of family and social support is an important determinant in nursing home entry (Miller and Weissert 2000). The factor has been studied less in terms of events during nursing home stays, however, and is worthy of additional attention.

F. References

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Table C-1. Cox Proportional Hazard Models of Mortality Risk

	Minnesota			New Jersey			Test H_0:
	Hazard Ratio	z		Hazard Ratio	z		$\beta_{MN}=\beta_{NJ}$ (p value)
Race (cf. White)							
Black	0.62	-3.39	***	0.71	-6.12	***	0.24
Other	0.83	-1.65	*	1.02	0.25		
Age (cf. 65-69)							
70-74	0.94	-0.66		0.84	-2.44	**	
75-79	1.13	1.54		1.11	1.69	*	
80-84	1.18	2.14	**	1.11	1.72	*	0.93
85-89	1.37	4.03	***	1.30	4.18	***	
90-94	1.57	5.65	***	1.51	6.17	***	
95+	1.81	6.58	***	1.68	6.21	***	
Male	1.58	15.93	***	1.55	14.53	***	0.76
Prior Medicaid	0.96	-1.33		0.83	-5.20	***	0.01
New Medicaid	0.95	-1.45		0.91	-2.28	**	
Barthel Index (cf. 0-20)							
21-40	0.33	-30.46	***	0.38	-24.69	***	
41-60	0.21	-38.21	***	0.28	-30.45	***	0.00
61-80	0.16	-42.15	***	0.19	-35.46	***	
81-90	0.12	-35.28	***	0.13	-32.10	***	
Charlson Index (cf. 0)							
1	1.13	3.15	***	1.04	0.98		
2	1.17	3.44	***	1.28	5.76	***	0.07
3	1.37	5.04	***	1.25	3.85	***	
4	1.70	7.36	***	1.46	5.77	***	
CPS Index (cf.0)							
1-2	0.89	-3.04	***	0.85	-4.39	***	
3-4	0.73	-8.30	***	0.68	-9.67	***	0.10
5-6	0.59	-9.74	***	0.65	-8.41	***	
Facility Ownership (cf. Govt)							
For Profit Private	1.09	1.70	*	1.22	3.09	***	0.12
Non Profit Private	1.04	0.87		1.06	0.88		
Facility Size (cf 0-60 beds)							
61-120	0.95	-1.11		0.94	-1.26		
121-180	1.07	1.31		0.93	-1.31		0.03
181-240	0.90	-1.74	*	0.93	-1.24		
240+	1.05	0.80		0.96	-0.66		
County Median Income (cf >$45K)							
< 35K	0.87	-1.40		0.90	-0.80		
35-40K	0.86	-2.17	**	1.00	0.06		0.01
40-45K	0.88	-1.74	*	1.09	1.95	*	
HMO Penetration (cf. <10%)							
10-25%	1.04	0.77		1.02	0.08		
25-40%	1.19	2.23	**	1.16	0.60		0.92
>40%	1.29	2.96	***	1.37	1.17		
Urban Influence (cf. Rural)							
Large Metropolitan	0.99	-0.06		1.05	1.12		
Small Metropolitan	1.09	1.28					
Adj. Lg Metro	1.26	2.60	***				0.01
Adj. Sm Metro	1.19	2.79	***				
Micropolitan	1.09	1.22					
Baseline HR (MN : NJ)	1.35	1.03					0.30
N (persons)	9644			9584			* p<10%
LR Test (χ^2)	3416.99			2829.27			** p<5%
P-value	0.00			0.00			***p<1%

Table C-2. Cox Proportional Hazard Models of Hospitalization (While in Original Facility)

	Minnesota			New Jersey			Test H_0:
	Hazard Ratio	z		Hazard Ratio	z		$\beta_{MN}=\beta_{NJ}$ (p value)
Race (cf. White)							
Black	0.84	-1.20		1.06	1.45		0.01
Other	1.40	3.52	***	1.03	0.52		
Age (cf. 65-69)							
70-74	0.86	-1.79	*	0.92	-1.42		
75-79	0.85	-2.07	**	1.01	0.13		
80-84	0.85	-2.25	**	0.99	-0.13		0.07
85-89	0.84	-2.35	**	1.05	1.01		
90-94	0.76	-3.44	***	0.95	-0.84		
95+	0.76	-3.02	***	0.95	-0.66		
Male	1.32	9.03	***	1.33	11.70	***	0.79
Prior Medicaid	0.98	-0.72		1.06	2.21	**	0.00
New Medicaid	0.86	-3.63	***	1.07	2.04	**	
Barthel Index (cf. 0-20)							
21-40	0.70	-8.09	***	0.73	-9.73	***	
41-60	0.65	-9.58	***	0.61	-14.78	***	0.14
61-80	0.60	-11.47	***	0.55	-18.07	***	
81-90	0.49	-13.61	***	0.48	-18.94	***	
Charlson Index (cf. 0)							
1	1.30	6.71	***	1.16	4.68	***	
2	1.40	7.53	***	1.40	10.14	***	0.09
3	1.49	5.86	***	1.65	11.68	***	
4	2.07	10.58	***	1.93	13.41	***	
CPS Index (cf.0)							
1-2	0.80	-5.92	***	0.89	-3.95	***	
3-4	0.70	-9.11	***	0.76	-8.98	***	0.00
5-6	0.41	-13.01	***	0.69	-8.62	***	
Facility Ownership (cf. Govt)							
For Profit Private	1.21	3.66	***	1.29	6.05	***	0.01
Non Profit Private	1.21	4.13	***	1.13	2.65	***	
Facility Size (cf 0-60 beds)							
61-120	0.97	-0.60		1.04	0.85		
121-180	0.89	-2.16	**	1.07	1.37		0.00
181-240	0.85	-2.45	**	1.08	1.49		
240+	0.85	-2.34	**	1.07	1.30		
County Median Income (cf >$45K)							
< 35K	0.98	-0.23		0.91	-0.89		
35-40K	0.96	-0.53		0.94	-1.27		0.00
40-45K	0.85	-2.34	**	1.12	3.26	***	
HMO Penetration (cf. <10%)							
10-25%	1.06	1.14		1.25	0.96		
25-40%	1.07	0.89		1.35	1.29		0.68
>40%	1.04	0.46		1.24	0.90		
Urban Influence (cf. Rural)							
Large Metropolitan	0.74	-2.90	***	1.01	0.15		
Small Metropolitan	0.92	-1.34					
Adj. Lg Metro	0.99	-0.10					0.00
Adj. Sm Metro	0.93	-1.43					
Micropolitan	0.97	-0.53					
Baseline HR (MN : NJ)	1.43	1.31					0.19
N (persons)	9644			9582			* p<10%
LR Test (χ^2)	843.76			1193.94			** p<5%
P-value	0.00			0.00			***p<1%

Table C-3. Cox Proportional Hazard Models of Medicaid Enrollment

	Minnesota		New Jersey		Test H_0:
	Hazard Ratio	z	Hazard Ratio	z	$\beta_{MN}=\beta_{NJ}$ (p value)
Race (cf. White)					
Black	1.41	1.45	1.38	3.42 ***	0.76
Other	1.09	0.44	1.28	1.32	
Age (cf. 65-69)					
70-74	1.14	0.97	1.29	2.04 **	
75-79	1.04	0.3	1.18	1.44	
80-84	1.00	0.03	1.38	2.9 ***	0.00
85-89	0.94	-0.48	1.53	3.81 ***	
90-94	0.93	-0.6	1.44	3.03 ***	
95+	0.91	-0.67	1.63	3.22 ***	
Male	1.01	0.21	0.79	-4.57 ***	0.00
Barthel Index (cf. 0-20)					
21-40	1.19	2.48 **	0.98	-0.33	
41-60	1.10	1.31	1.16	1.94 *	0.00
61-80	1.07	0.91	1.25	2.95 ***	
81-90	0.93	-0.89	1.51	4.93 ***	
Charlson Index (cf. 0)					
1	0.99	-0.22	0.97	-0.45	
2	1.01	0.14	0.99	-0.07	0.61
3	0.92	-0.67	1.05	0.41	
4	0.86	-0.94	1.12	0.94	
CPS Index (cf.0)					
1-2	1.19	3.13 ***	1.74	8.91 ***	
3-4	1.21	3.44 ***	1.88	9.9 ***	0.00
5-6	1.37	3.68 ***	1.91	6.82 ***	
Facility Ownership (cf. Govt)					
For Profit Private	0.96	-0.56	0.77	-2.44 **	0.02
Non Profit Private	0.89	-1.55	0.64	-3.93 ***	
Facility Size (cf 0-60 beds)					
61-120	0.97	-0.42	2.13	7.15 ***	
121-180	1.05	0.59	2.91	10.16 ***	0.00
181-240	0.88	-1.37	3.10	10.25 ***	
240+	0.94	-0.66	2.78	8.89 ***	
County Median Income (cf >$45K)					
< 35K	1.20	1.28	0.95	-0.25	
35-40K	1.22	1.86 *	1.07	0.65	0.94
40-45K	1.12	1.1	1.13	1.65 *	
HMO Penetration (cf. <10%)					
10-25%	1.06	0.69	2.25	1.58	
25-40%	1.22	1.7 *	2.59	1.87 *	0.47
>40%	1.23	1.68 *	2.65	1.83 *	
Urban Influence (cf. Rural)					
Large Metropolitan	1.21	1.23	1.09	1.13	
Small Metropolitan	1.32	2.76 ***			
Adj. Lg Metro	1.34	2.25 **			0.17
Adj. Sm Metro	1.27	2.63 ***			
Micropolitan	1.32	2.7 ***			
Baseline HR (MN:NJ)	10.72	4.14 ***			0.00
N (persons)	7039		6854		* p<10%
LR Test (χ^2)	72.89		480.17		** p<5%
P-value	0.00		0.00		***p<1%

Table C-4. Cox Proportional Hazard Models of Discharge to Lower Level of Care

	Minnesota		New Jersey		Test H_0:
	Hazard Ratio	z	Hazard Ratio	z	$\beta_{MN}=\beta_{NJ}$ (p value)
Race (cf. White)					
Black	1.50	2.61 ***	1.17	2.40 **	0.19
Other	1.39	2.41 **	1.10	0.73	
Age (cf. 65-69)					
70-74	0.92	-0.94	0.92	-1.24	
75-79	0.70	-4.13 ***	0.82	-3.08 ***	
80-84	0.54	-7.45 ***	0.64	-7.12 ***	0.55
85-89	0.46	-9.07 ***	0.51	-9.94 ***	
90-94	0.38	-10.41 ***	0.42	-10.77 ***	
95+	0.27	-9.62 ***	0.29	-8.65 ***	
Male	0.98	-0.51	1.07	1.89 *	0.09
Prior Medicaid	0.44	-15.96 ***	0.28	-21.84 ***	0.00
New Medicaid	0.23	-10.64 ***	0.20	-10.52 ***	
Barthel Index (cf. 0-20)					
21-40	1.48	4.60 ***	1.28	3.57 ***	
41-60	1.78	6.82 ***	1.76	8.38 ***	0.00
61-80	1.98	8.15 ***	1.67	7.34 ***	
81-90	1.63	5.37 ***	1.20	2.31 **	
Charlson Index (cf. 0)					
1	0.99	-0.16	0.77	-4.93 ***	
2	0.98	-0.32	0.72	-5.06 ***	0.00
3	1.17	1.68 *	0.76	-3.25 ***	
4	0.82	-1.57	0.74	-3.08 ***	
CPS Index (cf.0)					
1-2	0.54	-13.98 ***	0.42	-19.74 ***	
3-4	0.25	-25.29 ***	0.22	-26.06 ***	0.00
5-6	0.16	-14.66 ***	0.19	-16.02 ***	
Facility Ownership (cf. Govt)					
For Profit Private	1.61	5.17 ***	3.86	7.63 ***	0.00
Non Profit Private	1.29	2.88 ***	2.95	6.04 ***	
Facility Size (cf 0-60 beds)					
61-120	1.02	0.21	0.68	-6.51 ***	
121-180	1.26	2.99 ***	0.58	-8.89 ***	0.00
181-240	1.32	3.21 ***	0.50	-10.05 ***	
240+	0.89	-1.23	0.48	-9.06 ***	
County Median Income (cf >$45K)					
< 35K	0.92	-0.56	0.57	-2.80 ***	
35-40K	0.79	-2.16 **	0.96	-0.46	0.00
40-45K	0.78	-2.26 **	1.05	0.75	
HMO Penetration (cf. <10%)					
10-25%	1.02	0.23	0.75	-0.91	
25-40%	1.01	0.06	1.12	0.36	0.00
>40%	1.01	0.09	1.05	0.14	
Urban Influence (cf. Rural)					
Large Metropolitan	1.37	1.92 *	0.87	-2.45 **	
Small Metropolitan	0.90	-0.97			
Adj. Lg Metro	1.10	0.70			0.00
Adj. Sm Metro	1.06	0.66			
Micropolitan	1.11	0.93			
Baseline HR (MN : NJ)	0.81	-0.52			0.60
N (persons)	9644		9582		* p<10%
LR Test (χ^2)	2073.36		3627.48		** p<5%
P-value	0.00		0.00		***p<1%

Table C-4a. Cox Proportional Hazard Models of Discharge to Assisted Living

	Minnesota		New Jersey		Test H_0:
	Hazard Ratio	z	Hazard Ratio	z	$\beta_{MN}=\beta_{NJ}$ (p value)
Race (cf. White)					
Black	1.58	2.38 **	1.23	2.92 ***	0.09
Other	1.51	2.48 **	0.99	-0.08	
Age (cf. 65-69)					
70-74	1.14	1.10	0.89	-1.72 *	
75-79	0.82	-1.73 *	0.83	-2.82 ***	
80-84	0.64	-3.94 ***	0.62	-7.01 ***	0.06
85-89	0.58	-4.78 ***	0.50	-9.39 ***	
90-94	0.48	-5.91 ***	0.38	-10.64 ***	
95+	0.36	-5.97 ***	0.27	-8.10 ***	
Male	0.89	-2.13 **	1.08	1.80 *	0.00
Prior Medicaid	0.47	-11.69 ***	0.24	-20.78 ***	0.00
New Medicaid	0.29	-7.87 ***	0.21	-9.27 ***	
Barthel Index (cf. 0-20)					
21-40	1.63	4.52 ***	1.25	2.89 ***	
41-60	1.77	5.25 ***	1.75	7.66 ***	0.00
61-80	1.88	5.85 ***	1.57	5.89 ***	
81-90	1.49	3.39 ***	1.00	0.03	
Charlson Index (cf. 0)					
1	1.07	0.97	0.75	-4.68 ***	
2	1.02	0.24	0.71	-4.74 ***	0.00
3	1.33	2.46 **	0.78	-2.66 ***	
4	0.97	-0.20	0.72	-2.97 ***	
CPS Index (cf.0)					
1-2	0.58	-9.59 ***	0.40	-18.63 ***	
3-4	0.28	-18.41 ***	0.22	-23.77 ***	0.00
5-6	0.14	-11.37 ***	0.17	-15.01 ***	
Facility Ownership (cf. Govt)					
For Profit Private	1.53	3.71 ***	9.80	7.13 ***	0.00
Non Profit Private	1.25	2.02 **	7.03	6.06 ***	
Facility Size (cf 0-60 beds)					
61-120	0.88	-1.48	0.65	-6.46 ***	
121-180	1.14	1.40	0.56	-8.62 ***	0.00
181-240	1.00	0.04	0.52	-8.53 ***	
240+	0.85	-1.41	0.41	-9.56 ***	
County Median Income (cf >$45K)					
< 35K	1.10	0.53	0.64	-2.07 **	
35-40K	0.80	-1.70 *	1.06	0.71	0.00
40-45K	0.81	-1.56	1.09	1.30	
HMO Penetration (cf. <10%)					
10-25%	0.92	-0.81	1.03	0.07	
25-40%	0.95	-0.32	1.55	1.13	0.03
>40%	1.00	0.01	1.42	0.84	
Urban Influence (cf. Rural)					
Large Metropolitan	1.44	1.76 *	0.86	-2.49 **	
Small Metropolitan	1.10	0.66			
Adj. Lg Metro	1.40	2.00 **			0.11
Adj. Sm Metro	1.10	0.77			
Micropolitan	1.29	1.87 *			
Baseline HR (MN : NJ)	1.97	1.20			0.23
N (persons)	9644		9582		* p<10%
LR Test (χ^2)	1105.95		3363.75		** p<5%
P-value	0.00		0.00		***p<1%

Table C-4b. Cox Proportional Hazard Models of Discharge to Home

	Minnesota		New Jersey		Test H_0:
	Hazard Ratio	z	Hazard Ratio	z	
Race (cf. White)					
Black	1.37	1.18	0.92	-0.47	0.35
Other	1.17	0.66	1.55	1.79 *	
Age (cf. 65-69)					
70-74	0.68	-2.79 ***	1.18	0.96	
75-79	0.59	-4.31 ***	0.85	-1.00	
80-84	0.43	-6.85 ***	0.78	-1.50	0.04
85-89	0.35	-8.37 ***	0.59	-3.01 ***	
90-94	0.28	-9.04 ***	0.64	-2.42 **	
95+	0.17	-7.54 ***	0.41	-2.82 ***	
Male	1.12	1.77 *	1.07	0.72	0.62
Prior Medicaid	0.40	-10.95 ***	0.47	-6.50 ***	0.57
New Medicaid	0.16	-7.04 ***	0.19	-4.77 ***	
Barthel Index (cf. 0-20)					
21-40	1.25	1.61	1.50	2.25 **	
41-60	1.80	4.35 ***	1.78	3.28 ***	0.65
61-80	2.15	5.74 ***	2.28	4.74 ***	
81-90	1.84	4.28 ***	2.32	4.63 ***	
Charlson Index (cf. 0)					
1	0.87	-1.46	0.83	-1.53	
2	0.92	-0.76	0.77	-1.77 *	0.45
3	0.94	-0.35	0.67	-1.86 *	
4	0.62	-2.19 **	0.82	-0.90	
CPS Index (cf.0)					
1-2	0.49	-10.30 ***	0.52	-6.51 ***	
3-4	0.21	-17.32 ***	0.24	-10.38 ***	0.50
5-6	0.19	-9.17 ***	0.31	-5.32 ***	
Facility Ownership (cf. Govt)					
For Profit Private	1.72	3.56 ***	1.33	1.28	0.11
Non Profit Private	1.36	2.08 **	1.36	1.32	
Facility Size (cf 0-60 beds)					
61-120	1.34	2.25 **	0.79	-1.69 *	
121-180	1.54	3.18 ***	0.67	-2.72 ***	0.00
181-240	2.05	4.92 ***	0.33	-5.84 ***	
240+	1.01	0.06	0.80	-1.39	
County Median Income (cf >$45K)					
< 35K	0.66	-1.68 *	0.29	-2.04 **	
35-40K	0.77	-1.42	0.65	-2.10 **	0.07
40-45K	0.71	-1.79 *	0.90	-0.75	
HMO Penetration (cf. <10%)					
10-25%	1.25	1.46	0.28	-2.34 **	
25-40%	1.13	0.55	0.40	-1.76 *	0.01
>40%	1.06	0.25	0.41	-1.46	
Urban Influence (cf. Rural)					
Large Metropolitan	1.26	0.84	0.96	-0.28	
Small Metropolitan	0.64	-2.41 **			
Adj. Lg Metro	0.71	-1.46			0.00
Adj. Sm Metro	1.01	0.04			
Micropolitan	0.86	-0.87			
Baseline HR (MN : NJ)	0.37	-1.44			0.15
N (persons)	9644		9584		* p<10%
LR Test (χ^2)	1079.05		474.48		** p<5%
P-value	0.00		0.00		***p<1%

Table C-5. Short-stay Hospital Utilization and Spending

	Minnesota				New Jersey			
	Incidence of Utilization		Ln(Expenditure) among users		Incidence of Utilization		Ln(Expenditure) among users	
	Incidence Rate Ratio	z	Coefficient	t	Incidence Rate Ratio	z	Coefficient	t
Race (cf. White)								
Black	1.28	2.96 ***	0.23	2.04 **	1.13	4.27 ***	0.15	3.01 ***
Other Race	1.61	7.51 ***	0.24	2.82 ***	0.88	-2.23 **	-0.05	-0.49
Age (cf. 65-69)								
70-74	0.86	-2.71 ***	-0.11	-1.54	0.96	-0.92	-0.09	-1.35
75-79	0.87	-2.89 ***	-0.12	-1.81 *	1.09	2.36 **	-0.16	-2.77 ***
80-84	0.78	-5.00 ***	-0.22	-3.35 ***	1.19	5.00 ***	-0.16	-2.75 ***
85-89	0.78	-5.12 ***	-0.32	-5.02 ***	1.29	7.16 ***	-0.24	-4.15 ***
90-94	0.74	-5.73 ***	-0.40	-5.93 ***	1.26	5.70 ***	-0.37	-5.90 ***
95+	0.79	-3.33 ***	-0.42	-5.11 ***	1.35	5.14 ***	-0.33	-3.94 ***
Male	1.25	9.79 ***	0.04	1.52	1.25	11.78 ***	0.12	4.02 ***
Prior Medicaid	1.08	2.77 ***	0.01	0.31	1.10	4.06 ***	0.12	3.23 ***
Barthel Index (cf. 0-20)								
21-40	1.06	1.44	0.03	0.74	0.89	-3.98 ***	0.02	0.50
41-60	1.10	2.35 **	0.08	1.61	0.86	-5.27 ***	0.03	0.69
61-80	1.06	1.49	0.04	0.79	0.91	-3.31 ***	0.05	1.13
81-90	0.98	-0.42	0.06	1.20	0.95	-1.45	0.06	1.31
Charlson Index (cf. 0)								
1	1.67	17.76 ***	0.08	2.44 **	1.45	15.13 ***	-0.01	-0.16
2	1.99	21.37 ***	0.09	2.34 **	1.90	24.65 ***	0.15	3.67 ***
3	2.56	21.97 ***	0.24	4.34 ***	2.44	27.99 ***	0.22	4.21 ***
4	3.19	24.82 ***	0.37	5.64 ***	3.18	34.22 ***	0.47	7.64 ***
CPS (cf. 0)								
1-2	0.87	-5.14 ***	-0.14	-4.36 ***	1.13	5.71 ***	-0.03	-0.84
3-4	0.75	-10.22 ***	-0.29	-8.54 ***	1.10	3.98 ***	-0.12	-3.30 ***
5-6	0.54	-10.83 ***	-0.36	-6.07 ***	1.18	4.60 ***	-0.08	-1.43
Facility ownership (cf Govt.)								
For Profit Private	1.19	4.29 ***	0.08	1.68 *	1.17	4.01 ***	0.20	3.50 ***
Non Profit Private	1.19	4.43 ***	0.06	1.48	1.07	1.52	0.07	1.22
Facility size (cf. 0-60 beds)								
61-120	1.03	0.94	0.04	0.91	1.07	1.89 *	0.00	0.03
121-180	0.95	-1.24	0.04	0.89	1.09	2.52 **	-0.02	-0.46
181-240	1.07	1.47	0.10	1.92 *	1.04	1.16	-0.04	-0.79
240+	0.91	-1.70 *	0.13	2.01 **	1.09	2.25 **	0.05	0.86
Median Income (cf. >$45K)								
< 35K	0.88	-1.90 *	-0.14	-1.76 *	1.02	0.20	0.16	1.27
35-40K	0.91	-1.87 *	-0.13	-2.26 **	0.92	-2.32 **	-0.01	-0.12
40-45K	0.83	-3.43 ***	-0.20	-3.27 ***	1.03	1.06	0.06	1.43
HMO Penetration (cf.<10%)								
10-25%	1.05	1.20	-0.06	-1.41				
25-40%	1.05	0.89	0.01	0.09	0.97	-1.30	-0.03	-0.98
>40%	0.90	-1.58	0.01	0.10	0.88	-1.58	-0.24	-1.99 **
Urban Influence (cf. Rural)								
Large Metropolitan	0.67	-5.08 ***	0.05	0.56	1.04	1.54	0.11	2.50 **
Small Metropolitan	1.01	0.29	0.13	2.34 **				
Adjacent Lg Metro	0.98	-0.25	0.05	0.67				
Adjacent Sm Metro	0.98	-0.48	0.09	1.92 *				
Micropolitan	1.06	1.15	0.02	0.41				
Constant	0.00	-65.51 ***	9.19	76.48 ***	0.00	-97.11 ***	9.26	85.15 ***
* p<10%	N	9642	N	4161	N	9578	N	5303
** p<5%	Chi-squared	2297.23	R-squared	0.090	Chi-squared	717.03	R-squared	0.056
*** p<1%	D.F.	38			D.F.	33		

Table C-6. Skilled Nursing Facility Utilization and Spending

	Minnesota				New Jersey			
	Incidence of Utilization		Ln(Expenditure) among users		Incidence of Utilization		Ln(Expenditure) among users	
	Incidence Rate Ratio	z	Coefficient	t	Incidence Rate Ratio	z	Coefficient	t
Race (cf. White)								
Black	0.89	-0.96	0.36	2.06 **	1.06	1.32	0.21	3.35 ***
Other Race	1.24	2.47 **	0.15	1.22	0.72	-3.45 ***	-0.09	-0.70
Age (cf. 65-69)								
70-74	0.93	-1.08	0.13	1.31	0.97	-0.46	-0.04	-0.52
75-79	1.00	-0.02	0.23	2.48 **	1.22	3.63 ***	0.03	0.38
80-84	1.00	-0.03	0.19	2.11 **	1.47	7.23 ***	-0.02	-0.32
85-89	1.02	0.33	0.06	0.63	1.56	8.10 ***	-0.05	-0.72
90-94	1.00	0.01	-0.04	-0.41	1.50	6.73 ***	-0.10	-1.19
95+	1.03	0.32	-0.24	-2.10 **	1.51	4.81 ***	-0.29	-2.65 ***
Male	1.20	6.91 ***	-0.17	-4.73 ***	1.21	6.97 ***	-0.08	-2.26 **
Prior Medicaid	0.92	-2.30 **	-0.04	-0.78	1.04	1.15	-0.01	-0.21
Barthel Index (cf. 0-20)								
21-40	0.96	-0.95	0.11	1.74 *	1.02	0.41	0.05	0.92
41-60	0.92	-1.93 *	0.16	2.49 **	0.94	-1.36	0.03	0.45
61-80	0.88	-2.72 ***	-0.01	-0.23	1.00	-0.07	0.02	0.30
81-90	0.73	-6.13 ***	-0.01	-0.10	0.97	-0.72	-0.04	-0.59
Charlson Index (cf. 0)								
1	1.83	18.58 ***	0.02	0.44	1.45	10.59 ***	0.00	-0.08
2	2.17	21.26 ***	0.00	0.00	1.75	14.65 ***	-0.04	-0.70
3	2.39	16.73 ***	-0.10	-1.37	2.43	19.35 ***	0.06	0.96
4	3.05	19.34 ***	0.04	0.44	2.76	19.69 ***	-0.04	-0.47
CPS (cf. 0)								
1-2	0.93	-2.31 **	-0.10	-2.20 **	1.23	6.40 ***	0.02	0.56
3-4	0.82	-6.15 ***	-0.26	-5.63 ***	1.17	4.59 ***	-0.07	-1.61
5-6	0.63	-7.54 ***	-0.55	-6.73 ***	1.26	4.38 ***	-0.13	-1.90 *
Facility ownership (cf Govt.)								
For Profit Private	1.11	2.27 **	0.26	3.99 ***	0.98	-0.38	0.21	2.91 ***
Non Profit Private	1.21	4.39 ***	0.16	2.72 ***	0.87	-2.32 **	-0.07	-0.85
Facility size (cf. 0-60 beds)								
61-120	1.14	3.11 ***	0.04	0.69	1.04	0.90	-0.05	-0.81
121-180	1.00	0.04	-0.01	-0.13	1.05	1.04	0.04	0.57
181-240	1.32	5.24 ***	0.14	1.85 *	0.82	-3.69 ***	-0.06	-0.79
240+	0.97	-0.48	0.00	0.00	0.95	-0.95	-0.05	-0.65
Median Income (cf. >$45K)								
< 35K	1.09	1.15	0.13	1.22	0.78	-1.81 *	-0.21	-1.29
35-40K	1.02	0.37	0.08	0.97	0.76	-4.64 ***	0.06	0.78
40-45K	0.92	-1.22	-0.04	-0.52	0.94	-1.48	0.00	-0.03
HMO Penetration (cf.<10%)								
10-25%	1.03	0.69	-0.09	-1.52				
25-40%	1.04	0.55	-0.09	-0.95	0.97	-1.02	-0.12	-2.76 ***
>40%	0.86	-1.94 *	-0.21	-2.00 **	0.86	-1.22	-0.03	-0.18
Urban Influence (cf. Rural)								
Large Metropolitan	0.59	-5.68 ***	0.27	2.10 **	1.02	0.43	0.02	0.34
Small Metropolitan	0.80	-4.00 ***	0.08	1.00				
Adjacent Lg Metro	0.91	-1.35	0.16	1.61				
Adjacent Sm Metro	0.96	-0.85	-0.01	-0.10				
Micropolitan	1.01	0.21	0.04	0.50				
Constant	0.00	-58.85 ***	8.38	50.68 ***	0.00	-73.88 ***	9.02	64.01 ***
* p<10%	N	9642	N	3338	N	9578	N	3371
** p<5%	Chi-squared	1914.65	R-squared	0.066	Chi-squared	1164.91	R-squared	0.039
*** p<1%	D.F.	38			D.F.	33		

Table C-7. Medicaid Nursing Home Benefit Utilization and Spending

	Minnesota				New Jersey			
	Probability of Benefit		Ln(MCD Expend) among users		Probability of Benefit		Ln(MCD Expend) among users	
	Odds Ratio	z	Coefficient	t	Odds Ratio	z	Coefficient	t
Race (cf. White)								
Black	2.03	3.14 ***	0.14	1.05	1.58	5.14 ***	0.14	2.39 **
Other Race	1.27	1.26	0.16	1.31	1.28	1.66 *	-0.06	-0.58
Age (cf. 65-69)								
70-74	1.21	1.42	0.13	1.25	1.34	2.57 **	0.16	1.66 *
75-79	1.05	0.38	0.18	1.83 *	1.47	3.68 ***	0.09	1.03
80-84	1.09	0.69	0.22	2.33 **	1.73	5.43 ***	-0.02	-0.22
85-89	1.02	0.18	0.14	1.49	1.84	5.94 ***	-0.10	-1.21
90-94	0.96	-0.31	0.19	1.92 *	1.87	5.62 ***	-0.18	-2.00 **
95+	0.98	-0.15	0.13	1.09	1.80	3.93 ***	-0.32	-2.77 ***
Male	0.83	-3.87 ***	-0.32	-7.82 ***	0.72	-6.48 ***	-0.32	-7.60 ***
Prior Medicaid	15.95	27.58 ***	-0.04	-0.87	5.33	23.55 ***	0.16	3.90 ***
Barthel Index (cf. 0-20)								
21-40	1.38	4.25 ***	0.10	1.55	1.16	1.99 **	0.31	5.10 ***
41-60	1.56	5.72 ***	0.18	2.68 ***	1.48	5.12 ***	0.28	4.69 ***
61-80	1.63	6.27 ***	0.10	1.57	2.21	10.15 ***	0.45	7.66 ***
81-90	1.66	5.54 ***	0.16	2.11 **	3.06	12.58 ***	0.55	8.32 ***
Charlson Index (cf. 0)								
1	0.89	-1.85 *	-0.18	-3.29 ***	1.03	0.41	-0.16	-3.07 ***
2	1.07	0.87	-0.34	-5.51 ***	1.06	0.80	-0.12	-2.03 **
3	0.97	-0.22	-0.44	-4.98 ***	1.28	2.38 **	-0.35	-4.52 ***
4	0.89	-0.79	-0.44	-4.06 ***	1.11	0.85	-0.42	-4.42 ***
CPS (cf. 0)								
1-2	1.68	8.42 ***	0.21	4.12 ***	2.48	14.69 ***	0.18	3.56 ***
3-4	2.18	12.50 ***	0.43	8.30 ***	3.43	18.88 ***	0.23	4.27 ***
5-6	2.32	8.96 ***	0.55	7.08 ***	3.42	13.27 ***	0.18	2.47 **
Facility ownership (cf Govt.)								
For Profit Private	0.86	-1.67 *	-0.18	-2.65 ***	0.47	-6.87 ***	-0.43	-6.54 ***
Non Profit Private	0.82	-2.43 **	-0.17	-2.68 ***	0.45	-6.95 ***	-0.35	-4.86 ***
Facility size (cf. 0-60 beds)								
61-120	1.10	1.18	0.02	0.39	2.02	7.08 ***	-0.03	-0.32
121-180	1.02	0.25	-0.08	-1.16	2.85	10.59 ***	-0.01	-0.13
181-240	0.89	-1.18	-0.10	-1.12	3.67	12.38 ***	0.00	0.00
240+	0.98	-0.16	-0.07	-0.74	3.40	11.09 ***	-0.07	-0.72
Median Income (cf. >$45K)								
< 35K	2.38	5.51 ***	-0.05	-0.39	0.89	-0.52	0.02	0.08
35-40K	1.98	5.75 ***	0.06	0.60	1.08	0.74	0.10	1.44
40-45K	1.48	3.24 ***	-0.07	-0.67	0.97	-0.45	0.15	2.41 **
HMO Penetration (cf.<10%)								
10-25%	1.18	1.81 *	0.00	-0.01				
25-40%	1.17	1.18	-0.05	-0.49	1.08	1.15	-0.06	-1.11
>40%	1.16	1.04	-0.02	-0.15	0.95	-0.26	-0.26	-1.38
Urban Influence (cf. Rural)								
Large Metropolitan	1.60	2.66 ***	0.13	0.89	0.93	-1.00	0.11	1.90 *
Small Metropolitan	1.53	3.79 ***	0.06	0.68				
Adjacent Lg Metro	1.50	2.83 ***	-0.01	-0.08				
Adjacent Sm Metro	1.28	2.48 **	-0.10	-1.35				
Micropolitan	1.31	2.35 **	-0.02	-0.18				
Constant	0.14	-8.40 ***	10.10	54.30 ***	0.09	-12.02 ***	10.55	66.23 ***
* p<10%	N	9642	N	4451	N	9578	N	3968
** p<5%	Chi-squared	1812.99	R-squared	0.061	Chi-squared	2201.52	R-squared	0.078
*** p<1%	D.F.	38			D.F.	33		

Table C-8. Acute Care Hospitalization in Year Prior to Nursing Home Admission

	Minnesota				New Jersey			
	Incidence of Utilization		Ln(Expenditure) among users		Incidence of Utilization		Ln(Expenditure) among users	
	Incidence Rate Ratio	z	Coefficient	t	Incidence Rate Ratio	z	Coefficient	t
Race (cf. White)								
Black	1.31	1.43	0.30	2.49 **	0.95	-0.72	0.01	0.20
Other Race	1.28	1.50	0.13	1.36	0.67	-3.04 ***	0.16	1.31
Age (cf. 65-69)								
70-74	0.82	-1.56	-0.01	-0.15	1.01	0.16	-0.10	-1.09
75-79	0.87	-1.18	-0.04	-0.63	1.29	2.97 ***	-0.17	-2.08 **
80-84	0.90	-0.94	-0.22	-3.28 ***	1.44	4.37 ***	-0.22	-2.81 ***
85-89	0.91	-0.87	-0.31	-4.66 ***	1.64	5.79 ***	-0.27	-3.36 ***
90-94	0.85	-1.40	-0.42	-6.07 ***	1.55	4.65 ***	-0.42	-4.96 ***
95+	0.83	-1.39	-0.52	-6.12 ***	1.42	2.73 ***	-0.51	-4.46 ***
Male	1.00	-0.08	0.09	3.26 ***	1.03	0.57	0.11	2.85 ***
Prior Medicaid	1.34	4.76 ***	0.14	4.04 ***	1.20	3.12 ***	0.27	5.38 ***
Barthel Index (cf. 0-20)								
21-40	0.78	-3.40 ***	-0.17	-3.87 ***	0.69	-5.58 ***	-0.26	-4.51 ***
41-60	0.76	-3.67 ***	-0.20	-4.52 ***	0.60	-7.42 ***	-0.36	-6.13 ***
61-80	0.79	-3.30 ***	-0.17	-3.87 ***	0.64	-6.42 ***	-0.36	-5.99 ***
81-90	0.90	-1.20	-0.16	-3.03 ***	0.71	-4.36 ***	-0.35	-5.05 ***
CPS (cf. 0)								
1-2	1.05	0.93	-0.12	-3.59 ***	1.11	2.00 **	0.03	0.59
3-4	0.81	-3.64 ***	-0.21	-5.88 ***	0.87	-2.52 **	-0.12	-2.40 **
5-6	0.81	-2.32 **	-0.24	-4.22 ***	0.81	-2.55 **	-0.14	-1.95 *
Facility ownership (cf Govt.)								
For Profit Private	0.90	-1.26	-0.06	-1.33	0.82	-2.13 **	0.02	0.26
Non Profit Private	1.02	0.26	-0.02	-0.43	0.88	-1.27	0.08	0.93
Facility size (cf. 0-60 beds)								
61-120	0.86	-2.08 **	-0.02	-0.40	1.27	3.04 ***	-0.01	-0.16
121-180	0.70	-4.28 ***	-0.04	-0.89	1.34	3.69 ***	0.02	0.34
181-240	0.95	-0.49	0.04	0.63	1.07	0.82	-0.27	-3.49 ***
240+	0.88	-1.32	0.07	1.11	0.96	-0.49	-0.02	-0.25
Median Income (cf. >$45K)								
< 35K	1.03	0.21	-0.15	-1.83 *	0.64	-2.17 **	0.28	1.37
35-40K	1.12	1.02	-0.13	-2.10 **	1.11	1.18	0.31	3.93 ***
40-45K	1.02	0.21	-0.16	-2.46 **	1.21	2.78 ***	0.02	0.35
HMO Penetration (cf.<10%)								
10-25%	1.09	1.03	0.00	0.06				
25-40%	1.07	0.55	-0.07	-1.07	0.85	-2.95 ***	-0.19	-3.89 ***
>40%	0.85	-1.25	-0.03	-0.37	0.80	-1.19	-0.39	-2.23 **
Urban Influence (cf. Rural)								
Large Metropolitan	0.52	-4.00 ***	0.25	2.59 ***	1.29	3.90 ***	0.00	0.04
Small Metropolitan	0.90	-1.03	0.24	4.14 ***				
Adjacent Lg Metro	0.84	-1.30	0.04	0.56				
Adjacent Sm Metro	0.98	-0.25	0.00	0.06				
Micropolitan	1.37	3.01 ***	0.13	2.21 **				
Constant	1.80	2.78 ***	9.09	73.81 ***	0.87	-0.88	9.51	64.62 ***
* p<10%	N	9642	N	4327	N	9578	N	4614
** p<5%	Chi-squared	586.30	R-squared	0.082	Chi-squared	255.34	R-squared	0.046
*** p<1%	D.F.	34			D.F.	29		

Table C-9. Medicare SNF Utilization in Quarter Prior to Nursing Home Admission

	Minnesota			New Jersey		
	Probability of Utilization			Incidence of Utilization		
	Odds Ratio	z		Odds Ratio	z	
Race (cf. White)						
Black	0.62	-1.27		0.57	-3.44	***
Other Race	1.59	2.16	**	0.37	-3.14	***
Age (cf. 65-69)						
70-74	0.94	-0.31		1.41	1.62	
75-79	0.94	-0.39		1.80	3.04	***
80-84	0.89	-0.71		2.18	4.19	***
85-89	0.91	-0.53		3.00	5.94	***
90-94	0.97	-0.17		2.34	4.32	***
95+	0.99	-0.05		1.98	2.73	***
Male	1.04	0.51		1.02	0.26	
Prior Medicaid	1.26	2.58	***	1.37	3.15	***
Barthel Index (cf. 0-20)						
21-40	0.64	-4.32	***	0.65	-3.99	***
41-60	0.70	-3.37	***	0.52	-5.84	***
61-80	0.59	-4.92	***	0.41	-7.42	***
81-90	0.54	-4.80	***	0.46	-5.77	***
CPS (cf. 0)						
1-2	1.11	1.19		1.07	0.76	
3-4	0.84	-1.94	*	0.87	-1.41	
5-6	0.73	-2.27	**	0.64	-3.06	***
Facility ownership (cf Govt.)						
For Profit Private	0.82	-1.64		0.79	-1.43	
Non Profit Private	0.90	-0.93		0.99	-0.05	
Facility size (cf. 0-60 beds)						
61-120	0.87	-1.31		0.96	-0.33	
121-180	0.72	-2.64	***	0.86	-1.18	
181-240	0.74	-2.13	**	0.71	-2.34	**
240+	0.85	-1.10		0.77	-1.68	*
Median Income (cf. >$45K)						
< 35K	0.70	-1.66	*	1.07	0.19	
35-40K	0.87	-0.91		1.17	1.03	
40-45K	0.97	-0.20		1.06	0.53	
HMO Penetration (cf.<10%)						
10-25%	0.86	-1.31				
25-40%	0.79	-1.35		0.81	-2.26	**
>40%	0.79	-1.18		1.03	0.11	
Urban Influence (cf. Rural)						
Large Metropolitan	0.55	-2.50	**	1.32	2.33	**
Small Metropolitan	0.80	-1.54				
Adjacent Lg Metro	0.95	-0.31				
Adjacent Sm Metro	0.70	-2.70	***			
Micropolitan	0.84	-1.24				
Constant	0.51	-2.24	**	0.10	-7.62	***
* p<10%	N	9642		N	9578	
** p<5%	Chi-squared	139.77		Chi-squared	204.52	
*** p<1%	D.F.	34		D.F.	29	