Variations in Hospitalization Rates among Nursing Home Residents: The Role of Discretionary Hospitalizations

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Objective. To examine variations in hospitalization rates among nursing home residents associated with discretionary hospitalization practices.

Data Sources. Quarterly Medicaid case-mix reimbursement data from the state of Massachusetts served as the core data source for this study, which was linked with data from the Medicare Provider Analysis and Review file (MEDPAR) to specify hospitalization status, nursing facility attribute data from the state of Massachusetts to specify facility-level organizational and structural attributes, and data from the Area Resource File (ARF) to specify area market-level attributes. Data spans three years (1991–1993) to produce a longitudinal analytical file containing 72,319 person-quarter-level observations.

Study Design. Two-step, multivariate logistic regression models were estimated for highly discretionary hospitalizations versus those containing less discretion, and low discretionary hospitalizations versus those containing greater amounts of physician discretion.

Principal Findings. Findings indicate that facility case-mix levels and area hospital bed supply levels contribute to variations in hospitalization rates among nursing home residents. Highly discretionary hospitalizations appear to be most sensitive to patient diagnoses best described as chronic, ambulatory care sensitive conditions.

Conclusions. Findings suggest that defining hospitalizations simply in terms of whether an event occurs versus otherwise may obscure valuable information regarding the contribution of various risk factors to highly discretionary versus low discretionary hospitalization rates.

Key Words. Discretionary hospitalizations, nursing home transfers

Hospitalization rates among nursing home residents have gained the interest of policymakers as a potential target for Medicare cost-containment strategies. Added to the expected savings associated with reducing hospitalization rates, researchers also cite the potential benefit of reducing residents' risks of iatrogenic illnesses and psychological trauma (Fried and Mor 1997). Although research findings have identified mostly patient-level factors associated with residents' risk of experiencing a hospital transfer, anecdotal evidence suggests that propensity to hospitalize may vary widely across facilities, with case-mix

differences providing only partial explanation (Castle and Mor 1996). Recent findings that certain facility-level characteristics, such as special care units and increased physician–resident contact, are associated with decreased risk of hospitalization (Intrator, Castle, and Mor 1999), further bolster speculation regarding nonpopulation causes of variation in hospitalization rates. Despite the likelihood that variations in hospitalization rates across nursing homes reflect both under- and overutilization, most investigations have focused on the problem of overutilization, thus limiting our understanding of what factors may account for the nearly five-fold discrepancy in hospitalization rates across nursing homes (Castle and Mor 1996).

Findings from the larger body of geographic variations research exploring hospital use rates among community-based populations offers insight regarding methods that are likely to be useful in exploring variations in hospitalization rates among nursing home based populations. For example, previous studies have established that community hospital discharge rates for certain low discretionary conditions (e.g., myocardial infarction) exhibit much less dispersion among geographic regions relative to discharge rates for more highly discretionary conditions (e.g., transient cerebrovascular ischemia) (Paul-Shaheen, Clark, and Williams 1987)—where discretionary refers to the degree to which doctors face uncertainty regarding the use of in-hospital treatment versus other treatment options. While there is no consensus, many researchers believe that when clear and compelling medical guidelines are absent, decisions to hospitalize may be influenced by the availability of area resources, leading to what has been called, "supply-sensitive" hospitalizations (Wennberg 2002). Moreover, the extent to which supply-sensitive differences are observed through variations in hospitalization rates appears to vary with the level of professional discretion associated with a particular condition (Fisher et al. 2000; Roos, Wennberg, and McPherson 1988). Thus, it follows that hospitalizations among nursing home residents that can be classified as highly discretionary should also exhibit greater variability compared to less

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discretionary hospitalizations. In response, this paper posits that the extent to which highly discretionary conditions are more sensitive to contextual and supply-sensitive factors will be reflected in the role of facility-level organizational and structural factors and area-market health delivery factors in explaining variations of nursing home hospitalization rates, after controlling for differences in population case-mix. Since ideally, hospital transfers should be relatively invariant to contextual and market-level attributes, consideration of the discretionary level provides some optimism for expanding our understanding of the contribution of nonclinical factors to variations in hospital use among nursing home residents.

PREVIOUS RESEARCH

Community-based utilization studies have repeatedly shown that hospitalization rates vary widely across small geographic areas (Paul-Shaheen, Clark, and Willams 1987). Although some variation might be expected to occur due to demographic diversity across regions, attempts to adjust for differences in population case-mix have failed to attenuate wide disparities in hospitalization rates across even the most similar geographic areas of study (Wennberg and Gittelsohn 1982). Moreover, the disparity in hospitalization rates across geographic areas has persisted despite extensive changes to health care policy, including implementation of the Medicare and Medicaid programs (Fisher et al. 2000). The failure of factors such as population morbidity levels and insurance coverage rates to account for variations in hospitalization rates across neighboring regional areas underscores the likelihood that the observed disparity in hospital use reflects not only overusage, but underusage as well. Overusage implies unnecessary and costly use of scarce resources, while underusage implies insufficient health care provision to the medically needy.

Given the inability of factors such as differential morbidity and access levels across populations to explain small area variations in hospitalization rates, researchers Wennberg, Barnes, and Zubkoff (1982) advanced the professional uncertainty principle, which focuses on the contribution of the decisional component by physicians to hospital variation rates. The professional uncertainty principle holds that among physicians, a considerable level of professional discretion in deciding whether or not to hospitalize exists, due in part because at times medical conditions may lack widely established treatment protocols or clear and convincing evidence to support one

treatment option over another. Thus, when the relative benefit of one procedure is not well known over another procedure, physicians may face considerable uncertainty regarding which course of action to follow. At times, therefore, when standard treatment protocols are not widely established or broadly followed by practitioners, professional judgment to hospitalize may be highly discretionary. Furthermore, when ambiguity regarding treatment for a given condition exists, physicians' decisions may be influenced by the availability of local resources and the tendency to act under the assumption that "more is better," leading to marked variations in hospitalization rates across relatively small and demographically similar regions (Wennberg 2002; Fisher et al. 2000; Wennberg, Barnes, and Zubkoff 1982).

Research findings provide empirical support for the notion of supply-sensitive services contributing to variations in hospital use. For instance, rates of tonsillectomies were shown to vary across six Vermont regions from a low of 8 percent to a high of 65 percent. Interestingly, when the physicians practicing in the area with the highest rate of tonsillectomy referrals were informed of their greater tendency to choose surgery over other treatment options, the rate of tonsillectomy referrals dropped rapidly and significantly. Similar findings for procedures such as hysterectomies, prostatectomies, and varicose veins have also been reported (Wennberg, Barnes, and Zubkoff 1982). More recently, Fisher and colleagues (1994) examined unexplained variations in readmission rates between Medicare beneficiaries residing in two neighboring communities: Boston, Massachusetts, and New Haven, Connecticut. Findings indicated that regardless of the medical condition responsible for the first hospitalization event, Medicare beneficiaries from Boston held odds 1.64 times greater of being rehospitalized than did their New Haven counterparts.

Building upon the professional uncertainty hypothesis advanced by Wennberg and colleagues, researchers Roos, Wennberg, and McPherson (1988) developed a discretionary index scale, providing an empirical standard for examining variations in hospitalization rates associated with levels of discretion by physicians in decisions to hospitalize across geographically defined areas. Using a modified version of the Diagnostic Related Grouping (DRG) classification system the researchers calculated hospital admission rates across all hospital service areas located in Iowa, California, Massachusetts, and Maine. Findings revealed consistency in the amount of dispersion for specific modified DRGs across similar hospital service areas. Specifically, admission rates for conditions containing relatively low discretion, such as acute myocardial infarction, exhibited low rates of variation, while more

highly discretionary procedures, such as angina pectoris, exhibited greater amounts of variation in admission rates across comparable areas.

Later, separate works by Ellis and Ash (1988) and Anderson et al. (1989) developed classification schemes for rating medical diagnoses by level of associated physician discretion. Ellis and Ash provided physicians with lists of diagnostic codes in ICD-9-CM format (International Classification of Diseases, 9th Revision, Clinical Modification) and asked physicians to rate the level of discretion associated with prescribing in-hospital treatment over other available treatment options on three dimensions, which were summed for a composite score. The scores were then grouped into high, medium, and low classifications. Although Ellis and Ash's work aimed to improve upon the Adjusted Average Per Capita Cost (AAPCC) risk adjustment methodology for paying Medicare HMOs, their classification scheme provides a useful metric for specifying levels of discretion applicable to other types of utilization studies as well. Likewise, Anderson and colleagues (1989) also sought to improve upon the existing AAPCC risk adjustment methodology. Although their discretion classifications scale differed from that of Ellis and Ash's work, Anderson and colleagues provided a rigorous alternative to defining physician discretion. Using a questionnaire format, the researchers included a much larger pool of physicians, drawing from academic and fee-for-service providers and spanning 31 specialties. The authors considered two dimensions of physician discretion in developing their measure: level of physician discretion and degree of patient variation. Although Anderson et al.'s (1989) conceptualization of physician discretion remained similar to that of Ellis and Ash's work, the additional component of patient variation attempted to capture the range of discretion linked to any one particular diagnosis. Adopting a similar classification strategy, this paper examines the contribution of facility-level and area market-level supply factors in explaining variations in hospitalization rates across nursing homes.

Data and Methods

Data

This study relies on state Medicaid case-mix reimbursement data for nursing home residents from Massachusetts. Since 1991, nursing homes have been required to submit information about the current nursing needs of Medicaid residents using the Management Minutes Questionnaire (MMQ) at the time of conversion to Medicaid and quarterly thereafter. The

MMQ is completed by trained nursing staff who use a variety of sources, such as: medication tracking records, doctors' orders/progress sheets, daily professional nursing summaries, and so on. The MMQ thus provides a rich and detailed longitudinal source of resident-level data, including information on: demographics, functional impairment levels, medical diagnoses, medication use, and selected patient-level quality of care indicators. The MMQ data employed in this study were derived from a longitudinal analytic resident history file previously developed for a study of health outcomes of nursing home residents (Porell et al. 1998). The initial data file contained more than 78,000 quarterly MMQ records, spanning from April 1991 through March 1994. The file also contained information from three additional sources: (1) facility deficiency scores from state annual inspections; (2) annually measured facility-level organizational and financial variables from the Massachusetts Rate Setting Commission (MRSC), and (3) dates of death for residents from the Massachusetts Death Registry. Because facility-level contextual factors are a central focus of this study, 6,205 records (8 percent) with missing facility data in two or more data fields were dropped, leaving 72,319 person-quarters available for analysis. Nursing homes with missing data tended to be slightly newer, served a lighter case-mix of residents, had fewer Medicare reimbursed days as a percentage of all paid resident days, and were more likely to have recently changed ownership. Standard imputation techniques using multivariate regression analysis of facilities with complete data were employed for those records where only one field of data was missing.

The analytic MMQ file described above was augmented by merging information from four calendar years (1990–1993) of individual Medicare Provider Analysis and Review (MEDPAR) hospital claims data obtained by matching individual identifiers common to both MMQ and MEDPAR files. All Medicare inpatient hospital claims of Medicaid residents with at least one quarter of MMQ data for the calendar years 1990–1993 were contained in the MEDPAR file. Hospital records were first assigned to quarter-years on the basis of admission dates, aggregated by quarter, and subsequently merged to quarterly MMQ records of residents. Hospital stays that spanned two quarters were assigned to the first quarter in which the hospitalization originated. Additionally, county-level data from the Area Resource File (ARF) were merged to quarterly records for the specification of geographic market supply factor variables. Since the ARF data fields of interest were not available for each of the study years (1991–1993), 1992 data or the next most recent year of available data were used for all quarters.

Sample Characteristics

Approximately 79 percent of residents in the sample were female and had lived in the current nursing home for 3.5 years. The most prevalent primary diagnoses cited as responsible for resident nursing care needs included: hypertension (30 percent), dementia (21 percent), diabetes (15 percent), congestive heart failure (12 percent), osteoarthritis (11.5 percent), and Alzheimer's Disease (11 percent). Nearly 23 percent of quarterly observations in the sample were drawn from residents residing in a nonprofit facility, while 50 percent were from facilities operating under a management firm. Medicaid was the largest source of payment to nursing homes on behalf of residents in the sample, accounting for nearly 76 percent of all paid nursing home days on average. Statewide, in comparison, Medicaid financed 75 percent of all nursing home stays in the state of Massachusetts, while 95 percent of all Massachusetts facilities participated in the Medicaid program. Facilities spent nearly 23 percent of all nursing expenses for licensed practical nurses (LPNs), and approximately another 25 percent of nursing expenses for registered nurses (RNs). Facilities tended to operate in areas with relatively high rates of nursing home beds, with a sample average of 77 beds per 1,000 county residents. Similarly, an average of 36 hospital beds per 1,000 county residents was available.

This sample may not be representative of all nursing homes and all residents of nursing homes. Only Medicaid beneficiaries were included in this study, leaving questions about factors affecting hospital use by short-term Medicare beneficiaries or private pay residents in nursing homes largely unexplored. Restricting the study sample to one state may also limit the generalizability of findings, as prior research suggests that the state of Massachusetts as a whole may exhibit some distinctive market characteristics, such as increased supplies of nursing home beds, higher occupancy rates of available beds, and a greater proportion of Medicare and Medicaid reimbursed bed days, compared to national averages (Weinstein, Freedman, and Randle 1995). However, when comparing organizational attributes and resident population characteristics between nursing homes located in Massachusetts versus national averages, by and large similarities are more commonly observed (Harrington et al. 1996).

Additionally, some important policy changes have occurred since the study time period and these should be kept in mind in considering study findings. Most notably, the implementation of the Congressionally mandated Resident Assessment Instrument following the Omnibus Budget

Reconciliation Act of 1987 now requires all residents in licensed nursing homes to be evaluated upon admission and quarterly thereafter, providing a standardized industry approach to completing resident assessments with the aim of improving care (Hawes et al. 1997). Also, national trends toward greater reliance upon post-acute care following the implementation of the Prospective Payment System (PPS), which subsequently decreased lengths of hospital stays among Medicare beneficiaries, has resulted in increased levels of patient acuity in the nursing home (Holtzman and Lurie 1996).

Measures

Dependent Variables

Three outcome variables of interest were specified to model the event of hospitalization among nursing home residents. The first, Ever Hospitalized, was specified as a dichotomous variable set to unity if a resident experienced at least one hospital admission at any time during the quarter (time $t+1$) and zero, otherwise. The second, Low Discretion Hospitalization, was specified as a dichotomous variable set to one if at least one hospitalization occurred anytime during time $t+1$ *and* the decision to hospitalize for that episode was classified as containing low physician discretion, and zero otherwise. The criterion used in this study for a hospitalization to be classified as containing low physician discretion included having been identified as a low discretion hospitalization on each of the separate discretion scales developed by researchers Ellis and Ash (1988) and Anderson and colleagues (1989). This decision was made to ensure the validity and reliability of the measure. Although both sets of researchers relied upon expert physician opinion to develop their classification schemes, some disagreement between the two scales exist, leading to contradictory assignments (e.g., low discretion on one scale and high discretion on the other), most likely reflecting, at least in part, patient variation within a single diagnosis. The third, High Discretion Hospitalization, was specified as a dichotomous variable set to unity if at least one hospitalization occurred anytime during time $t+1$ *and* the decision to hospitalize, based on the ICD-9-CM principal diagnostic code, indicated a highly discretionary decision, and zero otherwise. For a hospitalization to be classified as highly discretionary, the hospitalization had to be identified by Ellis and Ash (1988) as highly discretionary, and could not be classified as low discretion by Anderson and colleagues (1989). Unfortunately, the cross-classification of the Ellis and Ash scale with the Anderson and colleagues scale, similar to that described above, did not work for highly discretionary

hospitalizations, because the cell numbers were too small for analysis. Therefore, hospitalizations classified as highly discretionary were based on the scale by Ellis and Ash. However, to improve reliability and validity of the measure, any hospitalization that would have received a contradictory classification on the Anderson et al. scale (i.e., designated as low discretion) was coded as "otherwise." It is important to note, however, that both researchers included a third category representing moderate discretion. For the purposes of this research, the respective residual categories for high discretion and low discretion hospitalizations each contain moderate discretion hospitalizations coded as "otherwise." That is, the "otherwise" categories overlap between the two models because of moderate discretion hospitalizations.

Independent Variables

Table 1 contains definitions, originating data source, and descriptive statistics for all independent factors included in the analyses. Since the justification for study inclusion and the approach in specification of study measures are conventional for the most part and have been described elsewhere (e.g., Castle and Mor 1996), discussion here is limited to those variables less frequently examined.

Resident Clinical Characteristics. The most compelling reason for using person-quarter observations rather than person-years stems from the extensive clinical data in the MMQ, which permits quarterly updates of resident diagnoses and functional status and allows for dynamic case-mix adjustment for population differences over time. Using ICD-9-CM codes, dummy variables were first specified for the 15 most prevalent diagnoses responsible for nursing home care in-state. Remaining clinical conditions were then coded into a set of residual diagnostic categories organized by body system.

Other Health/Risk Indicators. Several variables were specified to account for baseline health differences or patient-level quality of care indicators. Dummy variables indicating: (1) the presence of decubitus ulcers (defined as stage 2 or higher), (2) having sustained a reported accident within the past 90 days, (3) having experienced either unplanned weight gain or loss (+8/- 5 lbs) during the past 90 days, and (4) having daily or PRN orders for physical restraints were included in this study given their noted relationship to overall health and well-being. Additionally, dummy variables indicating hypnotic, tranquilizer, antipsychotic, or antidepressant drug use were also specified

Table 1: Definition, Source, and Description of Independent Measures

Variable	*Definition*	*Source*	*Mean(SD)* *Full Sample*[1]	*Hospitalized*[2]
Resident Characteristics:				
Male	Dummy variable, 1 = male; 0 = otherwise	MMQ	0.214 (0.410)	0.285 (0.452)
Age	Continuous, age in years	MMQ	82.937(11.847)	82.824 (9.561)
NH Length of Stay	Continuous, number of years stay in facility	MMQ	3.649 (4.054)	2.353 (3.346)
New Admission	Dummy variable, 1 = admission within last 90 days, 0 = otherwise.	MMQ	0.063 (0.244)	0.196 (0.397)
Resident Clinical Characteristics:				*Frequent NH*
Diagnoses	*A set of dummy variables indicating frequent, Primary NH*			
			Diagnoses (5 percent or more)[3]	
Cerebrovascular Disease	1 = ICD-9 437, 0 = otherwise	MMQ	0.038 (0.190)	0.035 (0.184)
Stroke	1 = ICD-9 436, 0 = otherwise	MMQ	0.068 (0.252)	0.071 (0.256)
General Symptoms	1 = ICD-9 780, 0 = otherwise	MMQ	0.081 (0.273)	0.071 (0.256)
Congestive Heart Failure	1 = ICD-9 428, 0 = otherwise	MMQ	0.119 (0.324)	0.153 (0.360)
Diabetes	1 = ICD-9 250, 0 = otherwise	MMQ	0.148 (0.355)	0.183 (0.387)
Hypertension	1 = ICD-9 401, 0 = otherwise	MMQ	0.229 (0.420)	0.222 (0.416)
Ischemic Heart Disease	1 = ICD-9 414, 0 = otherwise	MMQ	0.108 (0.310)	0.119 (0.324)
Dementia	1 = ICD-9 290, 0 = otherwise	MMQ	0.208 (0.406)	0.181 (0.385)
Chronic Air Obstruction	1 = ICD-9 496, 0 = otherwise	MMQ	0.073 (0.260)	0.115 (0.318)
Osteoarthritis	1 = ICD-9 715, 0 = otherwise	MMQ	0.115 (0.319)	0.090 (0.287)
Hip Fracture	1 = ICD-9 820, 0 = otherwise	MMQ	0.071 (0.257)	0.062 (0.240)
Alzheimer's Disease	1 = ICD-9 331, 0 = otherwise	MMQ	0.108 (0.311)	0.086 (0.282)
Psychosis	1 = ICD-9 298, 0 = otherwise	MMQ	0.058 (0.233)	0.058 (0.234)
Schizophrenia	1 = ICD-9 295, 0 = otherwise	MMQ	0.055 (0.229)	0.059 (0.216)
Parkinson's Disease	1 = ICD-9 332, 0 = otherwise	MMQ	0.051 (0.220)	0.056 (0.229)

Major Diagnostic Categories	*A set of dummy variables indicating MDC for those diagnoses not represented by High Frequency diagnoses.*					
Infections	1 = ICD-9 (001-139), 0 = otherwise	MMQ	0.017	(0.130)	0.017	(0.129)
Neoplasms	1 = ICD-9 (140-239), 0 = otherwise	MMQ	0.063	(0.243)	0.072	(0.259)
Endocrine	1 = ICD-9 (240-289), 0 = otherwise	MMQ	0.279	(0.448)	0.301	(0.459)
Nervous	1 = ICD-9 (320-389), 0 = otherwise	MMQ	0.321	(0.467)	0.285	(0.451)
Circulatory	1 = ICD-9 (390-459), 0 = otherwise	MMQ	0.616	(0.486)	0.652	(0.476)
Respiratory	1 = ICD-9 (460-519), 0 = otherwise	MMQ	0.127	(0.333)	0.196	(0.397)
Digestive	1 = ICD-9 (520-579), 0 = otherwise	MMQ	0.122	(0.327)	0.127	(0.333)
Genitourinary	1 = ICD-9 (580-629), 0 = otherwise	MMQ	0.075	(0.264)	0.102	(0.302)
Musculoskeletal	1 = ICD-9 (710-739), 0 = otherwise	MMQ	0.229	(0.420)	0.199	(0.400)
Skin	1 = ICD-9 (680-709), 0 = otherwise	MMQ	0.033	(0.179)	0.037	(0.190)
Congenital	1 = ICD-9 (740-759), 0 = otherwise	MMQ	0.016	(0.125)	0.010	(0.100)
Ill-defined	1 = ICD-9 (780-799), 0 = otherwise	MMQ	0.164	(0.370)	0.151	(0.358)
Injury/Poisoning	1 = ICD-9 (800-999), 0 = otherwise	MMQ	0.148	(0.355)	0.143	(0.350)
Other Health/Risk Indicators:						
Secondary Diagnoses	Count of comorbidities (0-3)	MMQ	2.344	(0.872)	2.423	(0.830)
Accidents	Dummy variable, 1 = Reported accident in the past 90 days, 0 = otherwise.	MMQ	0.117	(0.322)	0.129	(0.335)
ADL Status	Dummy variable, 1 = 4 to 5 ADL Impairments, 0 = otherwise	MMQ	0.779	(0.415)	0.791	(0.406)
Activity Level	Dummy variable, 1 = Regular participant in facility-led activities, 0 = otherwise.	MMQ	0.775	(0.417)	0.809	(0.393)
Weight Change	Dummy variable, 1 = Unplanned weight change (+8Lbs or –5lbs), 0 = otherwise.	MMQ	0.069	(0.254)	0.079	(0.270)
Restraints Applied	Dummy variable, 1 = Indicates daily or PRN restraint orders, 0 = otherwise.	MMQ	0.280	(0.449)	0.267	(0.442)
Decubitus Ulcers	Dummy variable, 1 = stage 2 or higher decubitus ulcer present 0 = otherwise.	MMQ	0.118	(0.323)	0.153	(0.360)
MMQ Score	Interval level score measured in ten-point intervals, reflecting overall care needs.	MMQ	18.758	(8.489)	18.942	(8.376)

continued

Table 1: (Continued)

Variable	*Definition*	*Source*	*Mean(SD)* *Full Sample*[1]	*Hospitalized*[2]
Last Year's Maximum DCG	*Set of dummy variables indicating maximum DCG score for all hospitalizations in the past year (reference category set to zero).*			
DCG 1-2	1 = DCG Score of 1 to 2, 0 = otherwise.	MEDPAR	0.071 (0.257)	0.122 (0.328)
DCG 3-4	1 = DCG Score of 3 to 4, 0 = otherwise.	MEDPAR	0.095 (0.293)	0.184 (0.387)
DCG 5-7	1 = DCG Score of 5,6, or 7, 0 = otherwise.	MEDPAR	0.033 (0.179)	0.077 (0.267)
Drug Usage	*Set of dummy variables indicating resident history of drug usage.*			
Hypnotics	1 = Daily or PRN use of Hypnotics at time *t*, 0 = otherwise	MMQ	0.104 (0.306)	0.112 (0.315)
Tranquilizers	1 = Daily or PRN use of Tranquilizers at time *t*, 0 = otherwise	MMQ	0.183 (0.386)	0.198 (0.399)
Antidepressants	1 = Daily or PRN use of Antidepressants at time *t*, 0 = otherwise.	MMQ	0.143 (0.350)	0.156 (0.366)
Antipsychotics	1 = Daily or PRN use of Antipsychotics at time *t*, 0 = otherwise.	MMQ	0.164 (0.371)	0.165 (0.371)
Facility Characteristics:				
Management	Dummy variable, facility operated by a management firm. 1 = management; 0 = otherwise.	MRSC	0.500 (0.499)	0.515 (0.500)
Nonprofit Status	Dummy variable indicating nonprofit status. 1 = nonprofit, 0 = otherwise.	MRSC	0.233 (0.422)	0.209 (0.407)
Intermediate Care Facility	Dummy variable indicating intermediate-level care facility. 1 = Intermediate Care Facility; 0 = otherwise.	MRSC	0.171 (0.377)	0.177 (0.382)
Operating Tenure	Continuous variable measuring number of operation years under current ownership.	MRSC	8.584 (5.823)	8.317 (5.777)
Medicare Paid Days	Medicare paid days as a percentage of total annual patient days	MRSC	3.367 (4.234)	3.284 (4.852)
Medicaid Paid Days	Medicaid paid days as a percentage of total annual patient days	MRSC	75.987(14.633)	77.158(14.432)
Mean Number of Operating Beds	Mean number of operating beds per facility.	MRSC	119.822(55.248)	117.630(52.897)
Cash Flow	Average facility assets as a percentage of facility liabilities	MRSC	0.164 (1.099)	0.198 (1.448)
Deficiency Status	Count of the number of deficiency citations received during the facility's inspection in the past year (0–55)	Public	4.763 (6.412)	4.481 (5.972)

LPN Staffing Expenses	Total expenses for LPN staffing as a percentage of total annual nursing expenses	MRSC	0.227	(0.097)	0.234	(0.115)
RN Staffing Expenses	Total expenses for RN staffing as a percentage of total annual nursing expenses.	MRSC	0.248	(0.113)	0.247	(0.194)
Facility Case-Mix	Facility average of individual MMQ Scores.	MMQ	18.653	(2.802)	18.478	(2.605)
Change in Ownership	Dummy Variable indicating that nursing home changed ownership in previous year. 1 = Owner changed; 0 = otherwise.	MRSC	0.015	(0.123)	0.015	(0.122)
Market Characteristics:						
County Specialty MDs	Total number of specialty physicians as a percentage of all area physicians.	ARF	37.647	(3.658)	37.988	(3.572)
County Hospital Beds	Total Number of Hospital Beds per capita.	ARF	0.357	(0.127)	0.372	(0.190)
County NH Beds	Total Number of NH Beds per capita.	ARF	0.772	(0.127)	0.764	(0.121)
Percent Urban	Urban dwelling residents as a percentage of all county residents.	ARF	0.169	(0.343)	0.155	(0.280)
Area Income Level	Average area income level per county.	ARF	37.643	(3.658)	37.988	(3.572)

[1]Full Sample analyses based on 72,319 person-quarters.

[2]Hospitalized Sample analyses based on 8,070 person-quarters.

[3]Due to comorbidities numbers do not add to 100.

given their noted relationship to poor health outcomes (Flanagan et al. 1997). A continuous measure reflecting overall nursing care needs, Total MMQ, was included as a severity measure. Finally, three diagnostic cost group (DCG) dummy variables were specified to distinguish residents with certain medical conditions placing them at much higher risk of subsequent hospitalization due to the nature of their illness and its treatment by physicians.

Ash et al. (1989) and Ellis and Ash (1995) employed diagnostic information from prior hospitalizations to develop a set of health status based DCG risk classifications intended for risk adjustment of Medicare health maintenance organization capitation payments. The DCG risk classifications are based on the principal diagnosis of inpatient hospitalizations judged to be nondiscretionary (i.e., physicians have little discretion but to hospitalize for treatment). The DCG risk categories are intended to reflect health status differentials, in the sense that persons assigned to higher risk DCG categories have illnesses that are associated with much higher than average expected future Medicare (Parts A and B) costs. The seven DCG risk classes of Ellis and Ash (1995), ordinally ranked on the basis of higher expected annual Medicare costs, were first collapsed into three classes: DCG1-2, DCG3-4, and DCG5-7. In each quarter, the principal diagnoses from all hospitalizations in the previous year were compared for each resident. Each resident was then assigned to the highest corresponding DCG risk class observed across the three classes over one year, or to an omitted reference risk class. Residents who were assigned to the omitted reference risk class had to satisfy one of two conditions: (1) either the resident was not hospitalized at all in the past year, (2) or all hospitalizations were deemed highly discretionary, and/or none of the hospitalizations were empirically associated with high subsequent year Medicare costs (Ellis and Ash 1995).

Facility Characteristics. Facility-level variables were specified for 527 Medicaid-eligible nursing homes in Massachusetts. Much interest has surrounded the question of whether quality of care differences can be attributable to the profit status of the facility (Spector, Selden, and Cohen 1998). To control for this possibility, a dummy variable indicating nonprofit status was included, as was a dummy variable indicating management by an operating chain versus otherwise. A continuous variable measuring years of operating tenure by the current facility owner was included, as was a dummy variable indicating recent change in ownership. Operating tenure should capture, at least in part, differences relating to experience in providing care, while change in ownership should provide a proxy measure for potential instability associated with ownership turnover. Several studies have indicated

that Medicare and Medicaid status affect outcomes of nursing home residents (Freiman and Murtaugh 1993; Shaughnessy et al. 1985). To investigate whether care styles associated with a facility's payor mix influences decisions to hospitalize, two facility-level measures were specified as the number of paid Medicare and Medicaid days respectively, each as a percentage of total annual days of care. As financial incentives may affect facility decisions to hospitalize, a measure of the availability of cash resources was specified as an indicator of financial operating health. To the extent that poor financial health curtails available resources for patient care, hospitalization risks should be lower in facilities with greater cash flow, expressed as a ratio of the average facility assets over total liabilities. Additionally, a summary count of all OBRA deficiency citations received during a facility's last state inspection was specified to tap into variations in quality of care practices across study facilities. Nursing staff expenses account for the bulk of facility operating costs and nursing staff levels have been advocated as quality of care indicators (Davis 1991). Measures of RN and LPN expenses, each expressed as a percent of total annual facility nursing expenses were specified to reflect potential differences in care associated with the relative mix of nursing staff. A facility average MMQ score was included as an indicator of the overall resident case-mix with respect to nursing care needs. Last, intermediate care facilities (ICFs) were identified with the use of an indicator variable set to one if the facility was licensed as an ICF, and zero otherwise.

Market Characteristics. Community-based population studies have long revealed wide variations in regional hospital utilization rates that are much more highly correlated with measures of physician and hospital bed supply than population health status differences (Wennberg and Gittlesohn 1982). While relatively little is known about the influence of such broad market area factors on nursing home residents' hospital use, similar influences are expected since most nursing home residents will be cared for by physicians from the local community. Three county-level market area variables were specified to reflect differences in market supply including: the percentage of area practicing physicians licensed for specialty practice; the total number of short-term hospital beds per 1,000 county population, and the total number of licensed nursing home beds per 1,000 county population. A fourth variable, urban dwelling residents as a percentage of all county residents, was included to capture the urban versus rural character of the county in which the nursing facility is located. The last market area attribute was specified to measure differences related to variations in average area income levels across the fourteen counties in Massachusetts.

Estimation Procedures

A two-step approach to modeling risk factors of high (low) discretionary hospitalization was used. Two-step logistic regression techniques allow the probability of one event to be estimated, when the occurrence of that event is not entirely independent from some other event, or when some process of self-selection is occurring, making the probability of one event conditional upon the first (Allison 1984). Here, the latter case of self-selection is pertinent because the risk of experiencing one specific type of hospitalization versus another type is conditional upon a hospitalization of any type actually occurring. First, a general model estimating the risk of hospitalization versus otherwise was specified. Second, given that at least one hospitalization occurred, a model estimating the risk that at least one of the hospitalizations was of a particular discretionary type was estimated. When interpreting parameter estimates, the following caveat applies. The two steps of the model essentially ask different questions, and thus, their respective results are interpreted slightly differently. The first step deals specifically with rates of hospitalizations, asking: "How likely is a nursing home resident, given the observed set of parameters, to be hospitalized?" The second step, focusing only on hospitalized nursing home residents, seeks to answer the question, "Among hospitalized nursing home residents, who is at greater (or lesser) risk for a certain type of hospitalization versus any other type of hospitalization?"

All three models were estimated following the same basic form. Logistic regression analyses were used to estimate a model in which the probability of experiencing at least one hospitalization in the subsequent quarter $t+1$ is specified to be a function of resident, facility, and market area attributes (as listed in Table 1) measured in quarter t. Table 2 presents the empirical results from each of the three models, including estimated coefficients, z-statistics, and the corresponding odds ratios (ORs) for statistically significant coefficient estimates ($p < .10$). Since most nursing home residents had multiple quarterly observations due to the longitudinal nature of the study data, it could not be assumed that the model error terms were independently distributed. Accordingly, the standard errors of all logit parameter estimates across all three models were adjusted to account for the expected nonzero covariance among the errors arising from repeated observations for residents over time with a maximum likelihood procedure developed independently by Huber (1981) and White (1980).

Table 2: Odds Ratios from Logistic Regressions: Comparing Factors by Hospitalization Type

	Ever Hospitalized (n = 72,319)		*Low Discretion (n = 8,070)*		*High Discretion (n = 8,070)*	
VARIABLES	*Odds Ratio*	*Pr> Chi-Sq.*	*Odds Ratio*	*Pr> Chi-Sq.*	*Odds Ratio*	*Pr> Chi-Sq.*
Resident Characteristics:						
Male	1.335	0.000				
NH Age	1.006	0.000	1.012	0.000		
NH LOS	0.942	0.000	0.965	0.002		
Newly Admitted	3.980	0.000			1.148	0.074
Resident Nursing Home Clinical Diagnosis (High Frequency):						
Alzheimer's					1.312	0.027
Dementia	0.837	0.000				
Hypertention	0.933	0.069				
Diabetes	1.260	0.000			1.162	0.095
CHF	1.147	0.002			1.490	0.000
Osteoarthritis	0.853	0.009				
Ischemic Heart	1.100	0.042				
General Symptoms						
Chronic Air Obstruction					1.358	0.028
Stroke						
Schizophrenia	0.868	0.065				
Parkinson's Disease	1.179	0.019				
Other Cerebrovascular						
Psychosis			0.782	0.061		
Hip Fracture			1.938	0.000		
Resident Clinical Diagnosis (Residual Major Diagnostic Grouping):						
Infections						
Neoplasms					0.704	0.004
Endocrine/Metabolic			0.854	0.045		
Nerve	0.906	0.021				
Circulatory	1.122	0.004				
Respiratory	1.313	0.000				
Digestive						
Genitourinary	1.217	0.000				
Skin						
Musculoskeletal						
Congenital	0.764	0.042				
Ill-Defined						
Injury/Poisoning						
Other Health/Risk Indicators:						
Secondary Diagnoses						
Change Weight	1.133	0.009				
Decubitus Ulcers	1.229	0.000				

continued

Table 2: (Continued)

	Ever Hospitalized (n = 72,319)		*Low Discretion (n = 8,070)*		*High Discretion (n = 8,070)*	
VARIABLES	*Odds Ratio*	*Pr> Chi-Sq.*	*Odds Ratio*	*Pr> Chi-Sq.*	*Odds Ratio*	*Pr> Chi-Sq.*
MMQ Score	1.004	0.083	0.989	0.033		
Accident	1.159	0.000	1.158	0.066		
DCG 1-2	2.077	0.000	0.761	0.003		
DCG 3-4	2.340	0.000			0.871	0.092
DCG 5-7	2.652	0.000	1.240	0.041	0.812	0.075
Hypnotics	1.153	0.001				
Tranquilizers	1.115	0.002				
Antidepressants	1.089	0.029				
Antipsychotics					0.822	0.0340
Cash Flow	1.027	0.075				
Change Owner						
Deficiency Status	0.992	0.001				
Facility Case Mix	0.966	0.000			1.035	0.013
ICF	0.818	0.000				
Management	1.070	0.030				
Average Operating Beds	0.999	0.005	0.999	0.074		
Nonprofit Status	0.914	0.021				
Operating Tenure						
Medicaid Paid Days	1.006	0.000				
Medicare Paid Days	0.987	0.001				
Pct LPN Expenses	1.421	0.008				
Pct RN Expenses						
Private Rate						
Market Characteristics:						
County Hospital Beds			0.663	0.095		
County NH Beds	0.623	0.003				
County Income	1.031	0.000				
County Urban Population						
County Specialty MDs	1.018					
Pseudo-R-Sq.	0.0931		0.024		0.0216	

RESULTS

Description of Hospitalizations

Overall, at least one hospitalization of any type occurred during 11 percent (8,070) of all resident-quarters (73,319). Approximately 20 percent of these were identified as high discretionary admissions, while another 25 percent were identified as low discretionary admissions. Among high discretion

admissions, congestive heart failure (23 percent), dehydration (13 percent), COPD (6 percent), atrial fibrillation (3 percent), and cardiac dysrhythmias (2 percent) represented the five most frequently recorded hospital diagnoses. Likewise, hip fracture (32 percent), bacterial pneumonia (12 percent), acute myocardial infarction (10 percent), stroke (9 percent), and intestinal obstruction (6 percent) were the five most frequent diagnoses among low discretion admissions. The proportion of high discretionary hospitalizations appeared to vary across nursing homes with low overall hospitalization rates. For instance, although nearly 20 percent of all hospitalizations were high discretion admissions, among nursing homes with below average hospitalization rates (defined as less than 4 percent), less than 7 percent of resident hospitalizations were high discretion admissions. Conversely, nursing homes with higher than average hospitalization rates (greater than 18 percent) appeared to have slightly fewer hospitalizations classifiable as low discretion admissions (22 percent), however, their rate of high discretionary was consistent with the sample average.

Risk of Hospitalization

Findings from the first step estimating risk of hospitalization versus otherwise (Table 2, column one), indicate that residents in nonprofit facilities, facilities with higher overall MMQ case-mix, facilities classified as ICFs, facilities with more operating beds, and facilities with a greater proportion of Medicare reimbursed patient days had a significantly lower risk of hospitalization than otherwise similar residents from other homes. In contrast, residents residing in facilities operated by management chains, facilities with a greater percentage of Medicaid reimbursed patient days, and facilities that spent a greater proportion of total nursing expenses for LPNs appear to be at greater risk of hospitalization. Findings also suggest that residents of nursing homes located in counties with more nursing home beds per capita experienced decreased odds of being hospitalized, while residents in nursing homes located in areas with higher income levels and areas with proportionately more specialty licensed physicians held increased odds of hospitalization. Overall, the findings provide strong support for the hypothesis that facility-level and area-market factors contribute to variations in hospitalization rates across nursing homes.

The main objective in modeling high (low) discretionary hospitalizations is to examine differences in the degree to which high (low) discretionary hospitalizations may be more (less) sensitive to facility-level or market-level

factors in explaining variations in hospitalization rates. Since greater amounts of physician discretion are thought to indicate lower levels of physician agreement, high discretion hospitalizations should be more strongly influenced by supply-sensitive factors than should less discretionary hospitalizations. In other words, the greater the amount of physician discretion in deciding whether to hospitalize a resident, the greater the likelihood that nonclinical factors will influence that decision. Alternatively, low discretionary hospitalizations should be more reflective of clinical need and less sensitive to contextual factors. Examining the relationship between discretionary levels and factors associated with variations should impart valuable insight into hospitalization practices in nursing homes.

Low Discretionary Hospital Admissions (LDHA)

A cursory review of Table 2 reveals notable differences between the equation estimating factors associated with risk for hospitalization in general (estimated on the full sample) with the equation estimating factors associated with having a low discretion hospitalization (estimated only on those person-quarters containing at least one hospitalization) versus otherwise. Specifically, only a few coefficients were significantly associated with distinguishing low discretion hospitalizations from other hospitalizations with more discretion, given that at least one hospitalization of any type actually occurred. Moreover, among factors that did bear significant associations, several represented unique findings or changed directional impact in comparison to results from the full model, providing empirical support for conceptually differentiating between types of hospitalizations.

Resident Characteristics. Among factors specified to control for resident attributes, two emerged as significant risk factors associated with low discretionary hospitalizations, although the size and direction of each remained relatively unchanged from those results observed in the full model. The odds-ratio for resident age (OR = 1.012, $p = .000$) indicates a slight increase in LDHA risk occurs with each additional year of age. The odds-ratio for nursing home length of stay (OR = .965, $p = .002$), on the other hand, suggests that the odds of a hospitalization being an LDHA versus otherwise, decrease by approximately 3.5 percent with each additional year of nursing home tenure, holding other factors constant.

Resident Clinical Characteristics. Among the set of factors specified to control for differences in resident medical conditions, none of the 13 factors identified as significant ($p = .10$) in the full model appear to contribute to risk of

LDHA in the second model. Although this runs contrary to study expectations, findings from the descriptive portion of the analyses suggest that the type of LDHA most frequently seen (e.g., fractures and pneumonia) most likely pose a risk to the entire nursing home population, and not those with a few select diseases. However, three of the clinical characteristics that were not statistically significant in the full model emerged as risk factors of LDHAs. Findings indicate that residents with a nursing home diagnosis of hip fracture appear to hold odds of LDHA nearly twice as large as compared to otherwise similar residents (OR = 1.94). Findings also suggest that hospitalized residents with endocrine/metabolic disorders and psychosis (depression) experience 15 percent and 22 percent reduced odds of LDHA, respectively. These findings suggest that, although residents with endocrine/metabolic disorders or depression do not appear to be any more (or less) likely to be hospitalized in general, when they are hospitalized, they are less likely to be admitted for an LDHA.

Other Health/Risk Indicators. Among this set of factors are several individual-level quality of care indictors and other measures controlling for individual health or physical functioning based on ADLs status and past histories of hospitalizations (DCGs). Despite the number of strong relationships present in the full model, only factors that could be described as measures of health status appeared to hold significant associations with LDHAs. Additionally, even though each of these factors was identified in the full model as a significant risk factor, the size and direction of the relationship differs across the two models for three of the five variables. For example, while only a modest impact, the calculated odds-ratio for resident MMQ score (a nursing need case-mix index score) indicates that there is a decreased risk of LDHA among residents with higher individual MMQ scores (OR = .99). At first glance, this finding may seem contrary to substantive expectations, especially given the directional change of impact observed between the two models. Yet, keeping in mind that the MMQ score represents a composite score measuring residents' overall expected nursing care demands, higher MMQ scores should identify residents with more time-consuming nursing care needs. Thus, the negative association between MMQ scores and risk of an LDHA probably reflects the presence of several complicated but diffuse nursing needs. Although unrelated yet simultaneous disease processes are somewhat unusual for younger populations, the same may not be true for nursing home residents, who, furthermore, often present atypically (Ouslander 1989).

Findings from the DCG measures indicate that the odds of being hospitalized with an LDHA are increased by 24 percent among residents with at least one prior hospital stay in the past year receiving a maximum DCG score of 5, 6, or 7 versus otherwise similar residents with a DCG score of zero. Yet, among all hospitalized residents, the odds of an LDHA are decreased for residents whose past maximum DCG score equaled 1 to 2. Since higher DCG scores generally involve more medically urgent cases with the greatest expectation for future high medical use, the positive association with LDHAs is not surprising, given that LDHAs represent hospital stays for conditions that physicians readily agree require hospitalization. The finding that although hospitalization risk increases in general, but decreases for LDHA specifically, potentially raises concern that hospitalizations associated with only modest future hospital use or cost, may actually pose somewhat of a greater risk to nursing home residents, supporting the statements advanced by Creditor (1993): "In many cases the decline cannot be attributed to the progression of the acute problem for which they are hospitalized. Even when the disease, such as pneumonia, is cured in a few days, or the hip fracture repair is technically perfect and uncomplicated, the patient may never return to the premorbid functional status" (p. 219).

Facility-Level and Market-Level Characteristics. Only one of the facility-level factors and one of the market-level factors significantly associated with LDHA, providing some support for study expectations, which held that rates of LDHA would be relatively invariant to contextual factors. Findings suggest that, among residents experiencing at least one hospitalization, residents residing in nursing homes with more operating beds on average held decreased odds for LDHAs. Specifically, the odds-ratio indicates that with every bed increase in the average number of operating nursing home beds, the risk that a hospitalization is an LDHA decreases by 1 percent (OR = 0.99), controlling for other influences. Given the modest nature of this finding, the result most likely reflects broader aspects of the market area, in that larger nursing homes tend to be located near more densely populated centers, which tend to have increased health care services. The final associated factor with low discretionary hospitalizations was the per capita supply of area hospital beds. Although not identified as a significant risk factor for hospitalization in the full model, among those residents experiencing at least one hospitalization, findings indicate that hospitalized residents residing in market areas with greater availability of hospital beds, compared to otherwise similar residents, experience reduced odds of being hospitalized for an LDHA. More precisely, odds-ratios indicate that for every one-bed increase in the number of area

hospital beds per 1,000 county inhabitants, the odds that a hospitalization is for an LDHA decrease by approximately 34 percent. This robust finding most likely suggests that, everything else being equal, the greater the availability of hospital beds, the more relaxed admission requirements are concerning discretionary hospitalizations, and conversely the scarcer the area hospital bed supply, the more likely those beds are used for patients whose medical conditions contain very little discretion regarding the need for hospital-based treatment. This may be pointing to a supply and demand spillover effect, where the resources in one market economy sharply affect the resource consumption in another market. In this case for example, the willingness of nursing homes to treat certain conditions in-house versus to transfer them out may be influenced by broader, area hospital market supply factors.

Highly Discretionary Hospitalization Admissions (HDHA)

This section of the analyses focuses on highly discretionary hospitalizations among nursing home residents with the aim of evaluating whether or not these types of hospitalizations are more sensitive to nonclinical factors relative to those medical conditions involving lesser discretion. Findings from the HDLA model alone provide only minimal support for this assumption. Rather, the results from these analyses are best understood in relation to the other two models of hospitalization risk.

Resident Characteristics. Interestingly, even though all four factors included among this set of factors significantly associated with risk of hospitalization in the full model, only one of the factors appeared to also affect whether or not an HDHA occurred. Odds ratios indicate that newly admitted hospitalized residents have 15 percent greater odds (OR = 1.15) of an HDHA than do otherwise similar nursing home residents. Since newly admitted residents are more likely to recently have had a prior hospital stay, this finding could reflect less stability in the overall health of newly admitted residents. Alternatively however, nursing home staff, being less familiar with newly admitted residents and the extent of their health needs, may be more apt to refer residents' complaints/symptoms to physicians and/or seek outside medical intervention rather than initiate in-house approaches to treatment.

Resident Clinical Characteristics. Several of the clinical factors measuring medical diagnosis in the nursing home significantly affected the odds that a hospitalization is classified as an HDHA. For example, among residents experiencing at least one hospitalization, residents with a nursing home diagnosis of Alzheimer's disease experienced 31 percent greater odds

(OR = 1.31) of having at least one HDHA, relative to otherwise similar patients. In contrast, having a nursing home diagnosis of Alzheimer's disease exhibited no discernible association in the full model for increased risk of hospitalization. Considered together, these findings suggest that although residents with Alzheimer's disease are no more (or less) likely to be hospitalized than residents without Alzheimer's disease, when they are hospitalized, highly discretionary conditions are more often the cause. Given the communication difficulties often faced by patients with Alzheimer's disease, these findings raise concern as to whether they have difficulty making their medical needs known in a timely and effective manner or whether potentially manageable symptoms are exacerbating due to delays in initiating treatment.

Residents with a medical history of congestive heart failure experienced 49 percent greater odds of being hospitalized for a highly discretionary condition in comparison to otherwise similar residents (OR = 1.49). Likewise, hospitalized residents with a nursing home diagnosis of diabetes faced an elevated risk for an HDHA relative to otherwise similar hospitalized residents (OR = 1.16). Although residents with chronic airway obstruction did not appear to be any more (or less) likely to be hospitalized in general, when a hospitalization did occur, it was more likely to be for an HDHA (OR = 1.36). Hospitalized residents with a nursing home diagnosis of neoplasm, on the other hand, appear to have 30 percent lower odds of experiencing an HDHA. Most likely, this reflects the seriousness of most cancers and perhaps, hesitance by nursing home staff to seek hospital treatment for comorbid conditions when the overall prognosis already may be critical.

Other Health/Risk Indicators. None of the facility-level quality of care indicators appear to meaningfully associate with the likelihood of an HDHA, with the exception of physical restraint use. Contrary to study expectations, odds-ratios indicate that among hospitalized residents, those who had either daily or PRN restraint orders in the nursing home held 14 percent reduced odds of HDHA than did otherwise similar residents, although in the full-model, physical restraints appeared to lessen the risk of hospitalization. Thus, initially, restraint use may decrease risk of hospitalization, but in the long term, it suggests that when a resident in restraints is hospitalized, the condition is significantly less likely to involve a highly discretionary clinical decision. The nature of this relationship is not entirely clear. Since residents for whom restraints are used generally exhibit behavioral/cognitive symptoms, the direction of association may be capturing something related to dementia. Alternatively, restraint use in nursing homes may reflect a broader, facility-level

policy that also affects hospitalizations. More research is needed to understand this seemingly contrary finding. Among the remaining factors included in this set, three of the indicators negatively associated with HDHAs. Two of these findings represent directional shifts in comparison to the full model, while the third factor emerged as significant, although previously it was unidentified as a contributing risk factor in the full model. For example, the odds of experiencing at least one HDHA are reduced by 13 percent (OR = 0.87) for hospitalized residents with a past yearly DCG score of 3 to 4, and by 19 percent (OR = 0.81) for those with a maximum DCG score of 5, 6, or 7 versus otherwise comparable residents with a DCG score of zero. Antipsychotic daily or PRN drug use appeared to lower the relative risk of experiencing at least one HDHA compared to otherwise similar residents.

Facility-Level and Market-Level Characteristics. Only one facility-level factor appeared to significantly affect the odds of experiencing an HDHA. Estimated log-odds indicated that residents residing in nursing homes with higher, overall average MMQ case-mix scores increased risk of HDHA. Specifically, the estimated odds ratio of 1.04 indicates that for every 10-unit increase in the average facility score, odds of an HDHA versus less discretionary hospitalization increases by 4 percent, everything else being equal. The directional shift in association makes this an interesting finding as it suggests that while nursing home residents with higher MMQ case-mix scores overall are less likely to be hospitalized in general, when they are hospitalized, it is more likely to be for a highly discretionary condition.

Discussion

Although study findings do not provide clear indication that supply sensitive conditions account for the wide variations in hospitalization rates observed across nursing homes, overall the results do demonstrate that defining hospitalization simply in terms of whether an event occurs versus otherwise may obscure valuable information regarding the contribution of various risk factors to variations in hospitalization rates. Although to date no comparable studies explore discretionary hospitalization practices among nursing home residents, findings from the literature exploring supply sensitive conditions and geographic variations among community-based populations provide some insight to findings discussed here. For instance, Fisher and colleagues (1994) compared hospital readmission rates between Boston, Massachusetts, and New Haven, Connecticut, and found that regardless of the original reason

for the hospitalization, readmissions were much more likely to occur in Boston. The authors speculate that bed availability and clinical decisions may blend together and thus affect area hospitalization patterns. Considered from this perspective, the findings here may help to explain why studies with similar objectives have reported inconsistent findings to date. For example, when viewed across models, the pattern of coefficients constructs a broad picture of cause and effect. For example, tracing the pattern of results across models provides a unique perspective on several of the more common medical diagnoses responsible for nursing home care needs among residents. Residents with Alzheimer's disease, for instance, while no more or less likely to be hospitalized in general, when admitted, are more likely to experience an HDHA, perhaps due to communication difficulties that may hinder staffs' ability to evaluate the needs of the resident. Results associated with several of the more frequent diagnoses among residents, such as diabetes or COPD, offer promise that medically unnecessary or potentially avoidable hospitalizations can be targeted for reduction without also limiting medically necessary hospitalizations as well. Clearly, residents with diabetes represent one subpopulation in the nursing home that stand to benefit from improved daily monitoring and increased medical attention. Targeted programs for these residents might include awareness training for nursing assistants, improved nutritional monitoring, more frequent blood glucose screenings, and skin conditioning programs to prevent necrotic breakdown, and so forth.

The relatively modest nature of the findings may reflect diagnostic coding schemes not adequately sensitive to the particular health patterns of very old, frail adults. Recent findings from a community-based sample provide some support for this conclusion. Porell (1999) examined Medicare hospital discharge records from four states, grouped into 761 geographic areas, and found that very little of the variation was explained by high discretion hospitalizations, leading the researcher to conclude that using a small portion of LDHA diagnostic codes might be more useful for understanding variations. The pattern of results here seems to also indicate that the measure for HDHA may not sufficiently discriminate truly high discretionary conditions from other, less discretionary conditions. Most likely, this reflects the degree of discretion associated within any single diagnostic category as well as between categories. Thus, although measures of LDHA appear to effectively identify those hospitalizations that physicians readily agree upon as medically warranted, defining HDHAs may be particularly difficult because the very component that identifies these as

discretionary may also vary a great deal, especially in the presence of comorbidities. Thus, considering the robust impact of the combined set of contextual factors in the general model, the more modest results here point to an important study limitation. Namely, the extent to which variations in HDHAs reflect differences in availability of supply sensitive services, as evidenced by differential effects from facility-level and market-level factors, is limited to the extent that the study measures accurately identify HDHAs among nursing home residents, who most likely present with several comorbidities, and perhaps, atypically as well.

Additionally, although the physician remains responsible for hospital admitting decisions, conceptually, the discretionary component of whether or not to hospitalize may rest with two parties. First, a member of the nursing home staff must bring to a physician's attention (either via telephone or transport) the resident's medical need. Second, once notified, the physician must then decide whether in-hospital treatment versus nursing home based treatment is warranted. The level of discretion in the nursing home in initiating physician care may reflect broader institutional policies, levels of experience and skill among nursing personnel, and availability of in-house resources. Chassin's (1993) Enthusiasm Hypothesis may provide some additional insight into this conceptualization of discretion. The Enthusiasm Hypothesis postulates that physicians practicing in certain areas make decisions that reflect an area penchant for one treatment option over another. Conceivably, nursing homes may vary in their "enthusiasm" for certain treatment approaches as well. Although a few studies have attempted to examine the role of nursing home staff in initiating transfers and the extent to which nursing home staff may influence physician's decisions to hospitalize residents, more research is needed to investigate the role of various care providers in the process of hospital transfer and to identify what nonclinical factors may contribute to hospital transfer among nursing home residents when the overall clinical imperative to do so is unclear.

Disentangling facility-level effects from broader area market effects appears to be more problematic. But clearly, market-level factors influence hospitalization practices across nursing homes, and the extent to which unnecessary hospitalizations reflect market-level effects is not entirely clear. Some relationship exists between availability of hospital beds per capita and discretionary admissions, and although this finding is consistent with the variations research literature, more is difficult to conclude. What is most likely partly responsible for obscuring the relative contribution of market factors to type-specific hospitalizations is the complicated interaction of several health

care markets, for example, hospitals, nursing homes, home health care agencies, and rehabilitation hospitals.

Although discretionary levels only partially explain variation in hospitalization rates associated with facility-level and market-level factors, findings presented here clearly illustrate that patient differences alone do not account for differences in hospital transfer practices across nursing homes. Variations attributable to nonclinical factors raise concerns that some patients are being hospitalized unnecessarily while others are not receiving acute care services promptly when needed for optimal health. Residents of nursing homes represent a particularly vulnerable group to such variations due to their reliance upon skilled nursing care, which suggests daily need of supportive therapies to avoid further deterioration. Thus, when the system relied upon to provide medical assistance contributes to the risk of unnecessary or preventable hospitalizations, identification of these risk factors is critical to developing new policies aimed at improving hospitalization practices in the nursing home. Most important, by understanding the effects of contextual factors to HDHA versus other, less discretionary hospitalizations, the most questionable hospitalization practices can be thoroughly examined for the possibility of achieving reductions while safeguarding those hospitalizations representing medically cogent treatment decisions.

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REFERENCES

Allison, P. D. 1984. *Event History Analysis: Regression for Longitudinal Event Data.* Newbury Park, CA: Sage Publications.

Anderson, G. F., D. Lupu, N. Powe, S. Horn, S. Antebi, J. Whittle, and E. Steinberg. 1989. *Payment Amount for Capitated Systems: Final Report.* Report to HCFA, cooperative agreement no. 17-C-98990/3-01. Baltimore: Center for Hospital Finance and Management, John Hopkins University.

Ash, A., F. Porell, L. Gruenberg, E. Sawitz, and A. Beiser. 1989. "Adjusting Medicare Capitation Payments Using Prior Hospitalization Data." *Health Care Financing Review* 10 (4): 17–29.

Castle, N. G., and V. Mor. 1996. "Hospitalization of Nursing Home Residents: A Review of the Literature, 1980–1995." *Medical Care Research and Review* 53 (2): 123–48.

Chassin, M. R. 1993. "Explaining Geographic Variations: The Enthusiasm Hypothesis." *Medical Care* 31 (5): S37–44.

Creditor, M. C. 1993. "Hazards of Hospitalization of the Elderly." *Annals of Internal Medicine* 118 (3): 219–23.

Davis, M. A. 1991. "On Nursing Home Quality: A Review and Analysis." *Medical Care* 48 (2): 129–66.

Ellis, R. P., and A. Ash. 1988. *Refining the Diagnostic Cost Group Model: A Proposed Modification to the AAPCC for HMO Reimbursement: Final Report.* A report to HCFA, cooperative agreement no. 18-C-98526/1-03. Boston: Department of Economics and Health Care Research Unit, School of Medicine, Boston University.

———. 1995. "Refinements to the Diagnostic Cost Group Model (DCG)." *Inquiry* 32 (4): 418–29.

Fisher, E. S., J. E. Wennberg, T. A. Stukel, J. S. Skinner, and S. M. Sharp. 1994. "Hospital Readmission Rates for Cohorts of Medicare Beneficiaries in Boston and New Haven." *New England Journal of Medicine* 331 (15): 989–95.

Fisher, E. S., J. E. Wennberg, T. A. Stukel, J. S. Skinner, S. M. Sharp, J. L. Freeman, and A. M. Gittelsohn. 2000. "Associations among Hospital Capacity, Utilization, and Mortality of U.S. Medicare Beneficiaries, Controlling for Sociodemographic Factors." *Health Services Research* 34 (6): 1351–62.

Flanagan, S. A., M. Monane, A. Chawla, D. Schroeder, and S. Tillisch. 1997. *Validation of Nursing Home Quality Indicators Study: Final Report.* A report to HCFA, cooperative agreement no. 18-C-90090/01. Cambridge, MA: Medstat Group.

Freiman, M. P., and C. M. Murtaugh. 1993. "The Determinants of the Hospitalization of Nursing Home Residents." *Journal of Health Economics* 12 (3): 349–59.

Fried, T. R., and V. Mor. 1997. "Frailty and Hospitalization of Long-Term Nursing Home Residents." *Journal of the American Geriatrics Society* 45 (3): 265–9.

Harrington, C., H. Carrillo, S. C. Thollaug, and P. R. Summers. 1996. *Nursing Facilities, Staffing, Residents, and Facility Deficiencies, 1991–1995.* San Francisco, CA: Department of Social and Behavioral Sciences, School of Nursing, University of California.

Hawes, C., V. Mor, C. D. Phillips, B. E. Fries, J. N. Morris, E. Steele-Friedlob, A. M. Greene, and M. Nennstiel. 1997. "The OBRA-87 Nursing Home Regulations and Implementation of the Resident Assessment Instrument: Effects on Process Quality." *Journal of the American Geriatrics Society* 45 (8): 977–85.

Holtzman, J., and N. Lurie. 1996. "Causes of Increasing Mortality in a Nursing Home Population." *Journal of the American Geriatrics Society* 44 (3): 258–64.

Huber, P. J. 1981. *Robust Statistics.* New York: Wiley.

Intrator, O., N. G. Castle, and V. Mor. 1999. "Facility Characteristics Associated with Hospitalization of Nursing Home Residents: Results of a National Study." *Medical Care* 37 (3): 228–37.

Ouslander, Joseph G. 1989. "Medical Care in the Nursing Home." *Journal of the American Medical Association* 262 (18): 2582–90.

Paul-Shaheen, P., J. D. Clark, and D. Williams. 1987. "Small Area Analysis: A Review and Analysis of the North American Literature." *Journal of Health Politics, Policy, and Law* 12 (4): 741–808.

Porell, F. W. 1999. "Geographic Variations in Hospital Discharge Rates and Discretionary Hospital Use." *Journal of Health Services Research and Policy* 4 (3): 147–53.

Porell, F. W., F. G. Caro, A. Silva, and M. Monane. 1998. "Facility-Level Outcome Performance Measures for Nursing Homes." *Health Services Research* 38 (6): 665–83.

Roos, N. P., J. E. Wennberg, and K. McPherson. 1988. "Using Diagnosis-Related Groups for Studying Variations in Hospital Admissions." *Health Care Financing Review* 9 (4): 53–62.

Shaughnessy, P. W., A. M. Kramer, R. E. Schlenker, and M. B. Polesovsky. 1985. "Nursing Home Case-Mix Differences between Medicare and Non-Medicare and between Hospital-Based and Freestanding Patients." *Inquiry* 22 (2): 162–77.

Spector, W. D., T. M. Selden, and J. W. Cohen. 1998. "The Impact of Ownership Type on Nursing Home Outcomes." *Health Economics* 7 (7): 639–53.

Weinstein, B. E., L. I. Freedman, and M. L. Randle. 1995. *Nursing Facilities in Massachusetts, 1989–1993.* A Report of the Massachusetts Rate Setting Commission. MRSC publication no. 17682-93-500-2195-MRSC, pp. 1–93. Boston: Office of Communications, Division of Health Care Financing and Policy.

Wennberg, J. 2002. "Unwarranted Variations in Healthcare Delivery: Implications for Academic Medical Centres." *British Medical Journal* 325 (7370): 961–4.

Wennberg, J., B. Barnes, and M. Zubkoff. 1982. "Professional Uncertainty and the Problem of Supplier-Induced Demand." *Social Science and Medicine* 16 (7): 811–24.

Wennberg, J., and A. Gittelsohn. 1982. "Variations in Medical Care among Small Areas." *Scientific American* 246 (4): 120–34.

White, H. 1980. "A Heteroscedasticity-Consistent Covariance Matrix Estimator and Direct Test for Heteroscdasticity." *Econometrica* 48 (4): 817–38.