Journal of HOSPITAL MEDICINE www.journalofhospitalmedicine.com

ORIGINAL RESEARCH

Disproportionate Effects of Dementia on Hospital Discharge Disposition in Common Hospitalization Categories

Robert Y. Lin, BA, MS, MD[1]*, Brian C. Scanlan, BA, MD[1], William Liao, BA, Truc Phuong Thanh Nguyen, BS, MD[2]

[1]Department of Medicine, Weill–Cornell Medical College, New York Presbyterian/Lower Manhattan Hospital, New York, New York; [2]Family Medicine Residency Program, Gwinnett Medical Center, Lawrenceville, Georgia.

BACKGROUND: The impact of dementia on hospitalization discharge dispositions (HDDs) in the United States has not been quantified, and dementia prevalence in various hospitalization categories has not been detailed in recent years.

OBJECTIVE: To characterize hospitalizations prevalent with dementia, and to examine the relationship between dementia and HDDs.

DESIGN: A retrospective cross-sectional study.

SETTING: 2000 to 2012 National Inpatient Sample databases.

PATIENTS: Hospitalizations in persons ≥65 years old assigned to 1 of 12 Diagnosis Related Groups (DRGs) with a high number of dementia patients.

INTERVENTION: None.

MEASUREMENTS: The databases were queried for 12 DRGs (versions 18/24). Predictor effects for dementia on HDD categories were modeled adjusting for other defined comorbidities/covariates using logistic regression. Adjusted predictor effects of dementia on HDD in the DRG groupings were determined. Dementia prevalence and trends were assessed.

RESULTS: Increasing proportions of dementia were noted in 4 DRGs studied. Dementia was strongly associated with being discharged to a nonhome setting. The most marked dementia effects were noted in DRGs 174 (gastrointestinal hemorrhage), 88 (chronic obstructive pulmonary disease), 182 (esophagitis/gastroenteritis), 138 (cardiac arrhythmias), 127 (congestive heart failure), and 89 (simple pneumonia and pleurisy), where there was at least a 76% reduction in the adjusted odds ratio (0.18–0.24) for home discharge. In contrast, DRGs 14 (stroke), 79 (respiratory infections/inflammations), and 320 (kidney/urinary infections) had a smaller reduction in dementia-associated adjusted odds ratio (0.41–0.46) for home discharge. DRGs 79 and 320 had the highest proportions of dementia (>10%).

CONCLUSIONS: Dementia proportions in many hospitalization categories have increased. The variable effect of dementia on home discharge suggests that dementia has a differential influence on hospital discharge disposition depending on the DRG. These findings have implications for healthcare allocation and long-term care planning. *Journal of Hospital Medicine* 2015;10:586–591. © 2015 Society of Hospital Medicine

The aging of the US population has profound effects on all aspects of healthcare. By 2050, 80 million Americans will be over age 65 years, and the proportion of the population over 85 years is expanding at 6 times the rate of the general population.[1] This major shift in demographics poses significant challenges to hospitalists and others who provide acute care. The prevalence of dementia mirrors the trend of increasing life expectancy. Age is the most significant risk factor for dementia.[2] The prevalence of Alzheimer's disease increases at a predictable rate, about 5% per year after age 65 years. Half of the participants in the Berlin Aging Study were demented at age 95 years.[3] The care of persons with dementia deserves attention, careful consideration, and planning, as they present special needs while hospitalized affecting outcomes, cost, and discharge planning.

It is uncommon for those over age 70 years to be free of chronic conditions that frequently require treatment in hospitals. A study of community-dwelling patients with mild Alzheimer's disease followed for 3 years found that two-thirds of the participants required at least 1 hospitalization.[4] Significant risk factors for hospitalization included age and burden of co-morbidity. Declines in global cognition, episodic memory, and executive function have been found in elderly patients after hospitalization controlling for severity of illness and preadmission cognitive status.[5] Furthermore, according to a review of Medicare data published by the Alzheimer's Association, hospital costs for treating any medical condition with coexisting dementia were over 3 times those of nondemented patients with the same condition.[6] The same study reported nursing home costs and home health provision to be 10.2 and 3.8 times the costs for nondemented recipients, respectively.

This study addresses 2 questions prompted by the observations above: What are the trends of dementia prevalence among patients admitted to hospitals for

*Address for correspondence and reprint requests: Robert Y. Lin, MD, 116 East 36th Street, NYASC, New York, NY 10016; Telephone: 212-686-6321; Fax: 212-686-6329; E-mail: drlin@robertylinmd.com

Additional Supporting Information may be found in the online version of this article.

Received: October 3, 2014; **Revised:** April 17, 2015; **Accepted:** May 12, 2015
 DOI 10.1002/jhm.2402
Published online in Wiley Online Library (Wileyonlinelibrary.com).

common acute medical conditions and which diagnoses impact substantially the likelihood of discharge to home? Awareness of the prevalence of dementia comorbidity with conditions that generate hospitalization can provide a stimulus for institutions to allocate appropriate resources to address the special needs of persons with cognitive impairment. Hospitalists and providers at all levels of care armed with this information can adapt their practices and interventions to influence outcomes and transitions in care.

METHODS

Basic Data and Design

We performed a retrospective cross-sectional study[7] of hospitalized patients using the National Inpatient Sample (NIS) of the Healthcare Cost and Utilization Project (HCUP), which contains annual hospital discharge data from a stratified, random sample of hospitals across the United States.[8] Data fields include diagnostic fields, procedure codes, age, sex, race, total charges, length of stay (LOS), admission source, and disposition status. The database for each year accessed contains hospital discharges accounting for 36,417,575 (2000) to 39,008,298 (2010) discharges per year. These databases for the years 2000 through 2012 allowed for examination of recent temporal trends in dementia, and assessment of dementia's association with discharge status after adjusting for relevant covariates.

Case Selection and Classification, and Data Elements

We defined dementia on the basis of International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9) codes for dementia described by Quan et al.[9] (331.2, 290.* and 294.1) or Alzheimer's disease (ICD-9 331.0). These ICD-9 codes being present in any diagnosis field classified the hospitalization as having dementia as a comorbidity. All databases used in this study had Diagnosis Related Groups (DRGs) coding for version 18 and the similar DRG version 24. Both DRG versions were used to tabulate the frequency of dementia coding by DRG. Twelve medical DRGs that were among the 20 highest number of dementia coding diagnoses for each year were identified. Orthopedic DRGs, degenerative nervous system disorders, organic disturbances and mental retardation, psychoses, and rehabilitation DRGs were excluded from the study to focus on medical disorders without dementia as a component of the principal diagnosis. The DRGs for sepsis were also excluded, because significant change in the coding relating to mechanical ventilation duration were made on later DRG versions during the study period, making comparisons between different study years difficult. The DRGs chosen as inclusion criteria were 79 (respiratory infections and inflammations [non–community-acquired pneumonia], 320 (kidney and urinary tract infections [UTI] age >17 years with complications or comorbidities [CC]), 141 (syncope and collapse with complications, comorbidities [syncope]), 14 (intracranial hemorrhage and stroke with infarction [stroke]), 89 (simple pneumonia and pleurisy age >17 years with CC [community-acquired pneumonia)], 127 (heart failure and shock [CHF]), 88 (chronic obstructive pulmonary disease [COPD]), 138 cardiac arrhythmias and conduction disorders [arrhythmia]), 316 (kidney failure [AKI]), 182 (esophagitis/gastroenteritis age >17 years with CC [enteritis]), 174 (gastrointestinal hemorrhage with CC [GI bleed]), and 296 (nutritional and miscellaneous metabolic disorders [dehydration]). Only hospitalizations of patients aged ≥65 years were included, as geriatric patients were of primary interest.

The Charlson comorbidities as updated by Quan et al. (12 comordities)[10] were queried using published enhanced ICD-9 algorithms.[9] Also tabulated were Alzheimer's disease (ICD-9 331.0) and falls (E880–E888).[4,11] The primary reimbursement status coded as Medicaid or self-pay was considered a field of interest, as it reflects socioeconomic status.[12] Medicare as the sole reimbursement source was also considered a field of interest, as this influences the hospital LOS requirement prior to reimbursable skilled nursing facilities (SNF) transfer.[13] Discharges were grouped into expired, discharge to home, transfers to SNF, and discharge to another acute-care facility. Admission source from an SNF was identified.

Data Handling, Statistical Analysis, and Graphical Representation

The number of hospitalizations with dementia coding for each DRG was tabulated for each year. Negative binomial regression was performed using SAS for version 9.1 (SAS Institute, Cary, NC) for Windows (Microsoft Corp., Redmond, WA) to analyze time (year) effect for dementia in each DRG using the GENMOD procedure, taking into account the total number of hospitalizations for that DRG as the offset variable[14] as previously described.[15]

Most summary data generation and all logistic regression analyses were performed using SPSS for Windows version 13 (SPSS Inc., Chicago, IL). Multinomial logistic regression was performed to determine the degree to which dementia influenced the odds of being discharged home using SNF discharges as the reference group, with adjustment for other variables. The predictor variables included the updated Charlson comorbidities[10] and gender. As all patients chosen were age 65 years or older, this Charlson predictor variable was not part of the primary model. Expanded models added predictor variables: admission source from SNF, decade of age, calendar year, Medicaid or self-pay status (socioeconomic status), Medicare alone status, and coding for a fall (E880–E888). Model fit was examined.[16] Regression analyses were performed without race, an identifier missing in a significant number of discharges (14%–28% per year).

TABLE 1. General Characteristics of Study Hospitalizations

DRG	Descriptor	Total No.		Median LOS		Discharge Dispositions (Dementia/Nondementia)			
		Dementia	No Dementia	Dementia	No Dementia	Home (%)	Transfer (%)	SNF (%)	Death (%)
79	Non–community-acquired pneumonia	415,127	1,958,315	6	6	21.4/37.8	1.4/2.0	63.5/47.7	13.8/12.4
14	Stroke	379,725	4,089,142	5	4	26.1/39.6	1.8/3.2	63.0/46.8	9.1/10.5
320	Urinary tract infection	540,994	2,889,678	4	4	35.2/56.7	1.0/1.2	61.8/40.2	2.0/1.9
141	Syncope	173,325	1,705,651	3	3	58.8/77.6	1.1/1.9	39.7/20.1	0.4/0.4
296	Dehydration	341,681	2,894,380	4	3	35.1/63.5	1.0/1.5	59.8/31.4	4.1/3.6
316	Acute kidney injury	243,264	2,812,584	5	5	31.2/58.9	1.5/2.5	59.7/31.6	7.6/6.9
89	Community-acquired pneumonia	591,555	6,530,468	5	4	32.7/66.0	1.3/1.8	58.2/27.5	7.8/4.7
182	Enteritis	167,677	3,430,585	4	3	51.7/81.5	1.1/1.4	45.4/15.9	1.7/1.2
88	Chronic obstructive pulmonary disease	183,486	5,654,875	4	4	49.8/80.6	1.1/1.3	46.9/16.4	2.3/1.7
127	Congestive heart failure	389,838	9,012,723	4	4	42.9/70.9	1.3/2.9	49.7/22.1	6.0/4.1
174	Gastrointestinal bleeding	233,665	3,482,551	4	4	38.6/74.5	1.4/2.2	55.7/20.4	4.3/2.9
138	Arrhythmia	162,629	3,279,538	4	3	46.6/78.0	2.9/4.9	47.2/14.7	3.3/2.4

NOTE: Twelve DRG dementia proportions, LOS, and dispositions: Non–community-acquired pneumonia (respiratory infections and inflammations), stroke = cerebrovascular accident (intracranial hemorrhage and stroke with infarction), urinary tract infections (kidney and urinary tract infections age >17 years with complications or comorbidities), syncope (syncope and collapse with CC), dehydration (nutritional and miscellaneous metabolic disorders), acute kidney injury (kidney failure), community-acquired pneumonia (simple pneumonia and pleurisy age >17 years with CC), enteritis = gastrointestinal disorders (esophagitis/gastroenteritis age >17 years with CC), congestive heart failure (heart failure and shock), gastrointestinal bleeding (gastrointestinal hemorrhage with CC), and arrhythmias (cardiac arrhythmias and conduction disorders). Transfer = transfer to a different acute-care facility. **Abbreviations:** CC, complications or comorbidities; DRG, Diagnosis Related Group; LOS, length of stay; SNF, skilled nursing facility.

RESULTS

General DRG Characteristics

The 12 DRG hospitalization dementia proportions are shown in Tables 1 and 2. The DRG hospitalizations studied constituted 29.8% of all hospitalizations in patients aged ≥65 years. The greatest number of hospitalizations was for DRG127 (CHF) and the least for DRG141 (syncope). The highest cumulative proportions of dementia codings (>13%) were associated with DRG79 (respiratory infections and inflammations [non–community-acquired pneumonia)] and DRG320 (urinary tract infections age >17 years with CC [UTI]) (Table 2). The cumulative proportions (for all years) of dementia codings encompassing all years were between 5% and 11% in DRG141 (syncope), DRG89 (community-acquired pneumonia), DRG316 (AKI), DRG174 (GI bleed), DRG296 (dehydration), and DRG14 (stroke). DRGs 88 (COPD), 182 (enteritis), 138 (arrhythmia), and 127 (CHF) had cumulative proportions >3% but <5%.

Patients hospitalized with dementia were older, had a higher proportion of females (range, 50.8%–73.9% dementia; range, 46.9%–69.8% nondementia), and had more falls (range, 1.5%–14.6% dementia; range, 0.9%–14.5% nondementia). The median LOS was 1 day greater for hospitalizations with dementia coding for DRGs 14 (stroke), 89 (community-acquired pneumonia), 138 (arrhythmia), 182 (enteritis), and 296 (dehydration) (Table 1).

TABLE 2. Time-Related Characteristics of Hospitalizations

DRG	Descriptor	Yearly Admissions for Each DRG (Range)	Year Effect for Dementia
79	Non–community-acquired pneumonia	158,155(2012)–198,048(2008)	Negative effect*
320	Urinary tract infection	205,540(2000)–325,294(2011)	NS
296	Dehydration	194,920(2012)–298,446(2002)	Negative effect†
141	Syncope	113,476(2000)–164,017(2009)	NS
14	Stroke	312,783(2007)–391,845(2000)	NS
89	Community-acquired pneumonia	462,245(2014)–640,114(2005)	Negative effect*
316	Acute kidney injury	111,127(2000)–351,942(2011)	Positive effect*
174	Gastrointestinal bleeding	269,621(2010)–302,099(2004)	Negative effect†
182	Enteritis	251,949(2000)–308,570(2005)	Positive effect‡
138	Arrhythmia	235,060(2000)–309,481(2011)	NS
127	Congestive heart failure	608,355(2012)–789,423(2001)	Positive effect‡
88	Chronic obstructive pulmonary disease	395,055(2004)–505,824(2011)	Positive effect†

NOTE: Non–community-acquired pneumonia (respiratory infections and inflammations), stroke = cerebrovascular accident (intracranial hemorrhage and stroke with infarction), urinary tract infections (kidney and urinary tract infections age >17 years with CC), syncope (syncope and collapse with CC), dehydration(nutritional and miscellaneous metabolic disorders), acute kidney injury (kidney failure), community-acquired pneumonia (simple pneumonia and pleurisy age >17 years with CC), enteritis = gastrointestinal disorders (esophagitis/gastroenteritis age >17 years with CC), congestive heart failure (heart failure and shock), gastrointestinal bleeding (gastrointestinal hemorrhage with CC), and arrhythmias(cardiac arrhythmias and conduction disorders). Transfer = transfer to a different acute-care facility. **Abbreviations:** CC, complications or comorbidities; DRG, Diagnosis Related Group; NS, not significant; SNF, skilled nursing facility. *$P < 0.0001$. †$0.01 < P < 0.05$. ‡$0.001 < P < 0.0001$.

Temporal Characteristics

Using negative binomial regression, a significant positive time effect for dementia (ie, a greater proportion of dementia hospitalizations was noted with more recent years) was observed in DRGs 316 (AKI), 127 (CHF), 182 (enteritis), and 88 (COPD) (Table 2). Negative time effects (ie, a lower proportion of dementia hospitalizations was noted with more recent years) were noted for DRGs 79 (non–community-acquired pneumonia), 89 (community-acquired pneumonia), 174 (GI bleed), and296 (dehydration) (Table 2).

Multivariate Effects of Dementia on Discharge Disposition

Nominal regression, using the Charlson comorbidities/variables only, showed that the presence of dementia was associated with an adjusted odds ratio of <0.5 (0.18–0.46) for being discharged home for all DRGs (Table 3). For DRGs 174 (GI bleed), 88 (COPD),

TABLE 3. Adjusted Odds Ratios With 95% Confidence Interval for the Predictive Effect of Dementia on Home Discharge

		Dementia With Charlson Variables Only			Dementia Enhanced Model		
	DRG	% Predicted	OR	95% CI	% Predicted	OR	95% CI
Non–community-acquired pneumonia	79	61.2	0.46	0.46–0.47	64.9	0.51	0.51–0.52
Stroke	14	61.9	0.46	0.46–0.47	65.5	0.55	0.54–0.55
Urinary tract infection	320	59.4	0.41	0.40–0.41	63.3	0.45	0.45–0.46
Syncope	141	79.4	0.34	0.34–0.34	80.2	0.39	0.38–0.39
Dehydration	296	66.5	0.31	0.31–0.31	68.5	0.36	0.36–0.37
Acute kidney injury	316	65.2	0.28	0.28–0.29	68.4	0.35	0.35–0.36
Community-acquired pneumonia	89	70.1	0.24	0.24–0.24	72.1	0.30	0.30–0.30
Enteritis	182	82.3	0.22	0.21–0.22	83.2	0.28	0.27–0.28
Chronic obstructive pulmonary disease	88	82.2	0.21	0.21–0.22	82.9	0.29	0.28–0.29
Congestive heart failure	127	75.3	0.27	0.27–0.27	76.8	0.33	0.32–0.33
Gastrointestinal bleeding	174	77.2	0.18	0.18–0.19	78.8	0.23	0.23–0.23
Arrhythmia	138	82.6	0.18	0.18–0.18	83.6	0.24	0.23–0.24

NOTE: Non–community-acquired pneumonia (respiratory infections and inflammations), stroke (intracranial hemorrhage and stroke with infarction), urinary tract infections (kidney and urinary tract infections age >17 years with CC), syncope (syncope and collapse with CC), community-acquired pneumonia (simple pneumonia and pleurisy age >17 years with CC), congestive heart failure (heart failure and shock), arrhythmias (cardiac arrhythmias and conduction disorders), acute kidney injury (kidney failure), enteritis (esophagitis/gastroenteritis age >17 years with CC), gastrointestinal bleeding (gastrointestinal hemorrhage with CC), and dehydration (nutritional and miscellaneous metabolic disorders). Enhanced model includes demographic and clinical variables other than the Charlson variables. **Abbreviations:** CC, complications or comorbidities; CI, confidence interval; DRG, Diagnosis Related Group; OR, odds ratio.

182 (enteritis), 138 (arrhythmia), 127 (CHF), and 89 [community-acquired pneumonia], the adjusted odds ratio was 0.18 to 0.24 (a ≥76% reduction in the adjusted likelihood for being discharged home). In contrast, DRGs 14 (stroke), 79 (non–community-acquired pneumonia), and 320 (UTI) had adjusted odds ratios of 0.41 to 0.46 (a <60% reduction in the adjusted likelihood for being discharged home). Including additional covariates other than the Charlson criteria resulted in higher odds ratios and better model fits, but had the same dichotomy of dementia effect odds ratios (Table 3). The proportion of hospitalizations with disposition correctly predicted by the Charlson comorbidities alone ranged from 59.4% to 82.6% (Table 3). All models predicted a greater proportion of cases than expected by chance alone, with models also including non-Charlson covariates showing modestly better fits (Table 3). Dementia had the lowest odds ratio associated with home discharge among all the Charlson comorbidities for all DRGs studied. Collinearity of predictor (independent) variables was demonstrated only in DRG 88 (COPD) and in DRG 127 (CHF) with the respective COPD and CHF Charlson variables. Removing these variables from the respective predictor models in those DRGs did not change the odds ratio associated with dementia (data not shown). Performing nominal regression excluding patients transferred to acute facilities slightly improved model fit but did not significantly change the odds ratios (data not shown).

DISCUSSION

We found that dementia diagnosis has a significant negative impact on the likelihood of discharge to home for all the common acute medical conditions prompting hospitalization. The magnitude of this association varied significantly among DRGs. We found that dementia comorbidity strongly predicts nonhome discharge locations for a number of chronic conditions such as CHF and COPD. These findings could help inpatient and outpatient providers better anticipate post–acute-care needs. In addition, the increases in dementia-associated admissions for CHF and COPD highlight a need to understand how the growing dementia population may impact hospitals' public reporting (and penalties) of hospital readmissions or ambulatory care-sensitive hospitalization.

The prevalence of dementia over time changed for particular DRGs. We found hospitalizations for CHF and COPD DRGs to have an increase in dementia proportions over time. CHF and COPD are conditions with a prevalence of dementia comorbidity among Medicare recipients of 16% to 17%.[17] These 2 diagnoses, as well as dementia, have been shown to have statistical predictor effects for acute ambulatory-care sensitive hospitalizations.[18] Ambulatory care-sensitive conditions[19] and nursing home–sensitive avoidable conditions are proposed indicators/classifiers of hospitalizations that could have been avoided by care in their respective nonhospital settings.[20,21] The increasing dementia proportion over time in both CHF and COPD DRGs suggests that dementia may increasingly contribute to avoidable hospitalizations. The decrease in dementia proportion over time was in conditions that could be characterized as acute conditions (community-acquired pneumonia, non–community-acquired pneumonia, dehydration, and GI bleed), whereas the conditions with increasing dementia over time included at least 2 chronic conditions, namely CHF and COPD. It is not known why AKI and enteritis should also be associated with increasing dementia over time. These patterns may reflect differences in management. For example, certain acute conditions in

dementia patients may have been increasingly treated in the nonhospital setting, avoiding hospitalization.

Medically unnecessary hospitalizations have been the focus of initiatives by the Centers for Medicare & Medicaid Services, and include the readmission reduction program[22] and the recovery audit program's prepayment review demonstration.[23,24] Several of the DRGs with stronger dementia effects on discharge disposition have been targets of these programs, including CHF, community-acquired pneumonia, and COPD in the former, and GI bleed, enteritis, and syncope in the latter. The findings of the current study demonstrate that the presence of dementia strongly influences discharge disposition more in certain diagnostic categories. Although disease severity, care access, preventative measures, or provider behavior may have affected the outcomes, the findings raise the distinct possibility that dementia care could have driven admission patterns differentially. Increased awareness of the influence of dementia on hospitalizations and hospitalization discharges is important not only for clinicians but also for the payors, who may penalize (through denial of hospitalization reimbursement) acute-care facilities motivated to provide support to dementia patients who are unable to receive adequate care in the community. Furthermore, related to this issue is the Medicare policy that disallows reimbursement for SNF transfer admissions unless preceded by a 3-day acute-care hospitalization.[25] Hospitals often face a dilemma of whether to admit patients and keep them hospitalized for the requisite period of time to allow for SNF care to be provided, or to deny this option to patients by discharging them sooner (or not admitting them at all).

Demented persons are frequent visitors to emergency departments, and often the impairment in fundamental activities of daily living is immediately apparent to the nurses and physicians caring for them. How does hospital staff come to grips with the potential conflict between duty to the patient and financial solvency of the institution? When dementia is the chief concern but not an acceptable indication for admission (eg, clinical indication for inpatient care[26]), a search for a reimbursable DRG may ensue, and this could contribute to the variability of dementia comorbidity's impact on hospital discharge disposition noted in this study.

This study has strengths in that the data are sampled in a manner that allows national estimates to be made. Although administrative data, such as the NIS, have limitations in coding accuracy/variability, important quality factors influencing relevant outcomes in the United States have been quantified using the NIS.[27] Because the data were deidentified and sampled rather than being complete, readmissions could not be assessed. Readmission is an important measure of the effectiveness of comprehensive geriatric care models[28] and patient-centered care. It is possible that more readmissions for the same patient in the same year could have accounted for some of the trend findings. Furthermore, readmissions for the same patient in a given year could have impacted on the time-related dementia prevalence calculations used. Changes in coding practices also could have impacted the dementia prevalence trends noted.

This study utilized comorbidities that have been typically used to characterize inpatient mortality.[10] The focus of this study, however, was not on mortality but on home discharge. The use of multinomial logistic regression instead of binomial logistic regression was based on the intention to examine home discharge using skilled nursing facility discharge as a reference but also incorporating—and accounting for—other significant dispositions in the model such as death and other institutional transfers. Quan et al.[10] used the C statistic to describe and compare a mortality prediction model fit with the Charlson versus other comorbidity indices in national datasets. This statistic, however, is not used in multinomial logistic regression. Thus, it is difficult to compare the present modeling with the published models based on mortality (as a dichotomous outcome). The logistic regression models generally showed highly significant predictor effects for all predictor variables utilized (including dementia), but with a variable degree of correct prediction of disposition.

We originally hypothesized that hospitalized patients with dementia would require care in settings other than home at discharge, based on various key clinical and demographic factors, and that dementia comorbidity would display similar adjusted predictor effects for various common DRGs. Our findings of greater dementia-associated odds ratios for particular DRGs suggest a more complex and variable dementia role in certain types of hospitalization, and that there are potential limitations in using Agency for Healthcare Research and Quality prevention quality indicators,[7,26] developed for the purpose of tracking hospitalization data to assess quality and access to community-based medical care.

Acknowledgements

The authors acknowledge the assistance of Suh Lee, BA, during the summer of 2012. This work was supported in part by an intramural grant from New York Medical College.

Disclosure: Nothing to report.

References

1. Federal Interagency Forum on Aging-Related Statistics. Older Americans 2012: key indicators of well-being (older Americans 2012). Washington, DC: US Government Printing Office; 2012.
2. Alzheimer's Organization. Risk factors. Available at: http://www.alz.org/alzheimers_disease_causes_risk_factors.asp Accessed February 15, 2015.
3. Baltes PB, Mayer KV, eds. The Berlin Aging Study: aging from 70 to 100. Cambridge, United Kingdom: Cambridge University Press; 1999.
4. Rudolph JL, Zanin NM, Jones RN, et al. Hospitalization in community-dwelling persons with Alzheimer's disease: frequency and causes. *Am Geriatr Soc*. 2010;58:1542–1548.
5. Wilson RS, Hebert LS, Scherr PA, Dong X, Leurgens SE, Evans DA. Cognitive decline after hospitalization in a community population of older persons. *Neurology*. 2012;78:950–956.
6. Alzheimer's Association. Alzheimer's disease and chronic health conditions: the real challenge for 21st century Medicare. Alzheimer's

Association website. Available at: https://www.alz.org/national/documents/report_chroniccare.pdf. Published 2003. Accessed February 15, 2015.
7. Grimes DA, Schulz KF. An overview of clinical research: the lay of the land. *Lancet*. 2002;359:57–61.
8. Agency for Healthcare Research and Quality. Healthcare Cost and Utilization Project. HCUP databases. Available at: www.hcup-us.ahrq.gov/nisoverview.jsp. Modified December 11, 2013, Accessed May 31, 2015.
9. Quan H, Sundararajan V, Halfon P, et al. Coding algorithms for defining comorbidities in ICD-9-CM and ICD-10 administrative data. *Med Care*. 2005;43:1130–1139.
10. Quan H, Li B, Couris CM, et al. Updating and validating the Charlson comorbidity index and score for risk adjustment in hospital discharge abstracts using data from 6 countries. *Am J Epidemiol*. 2011;173:676–682.
11. Tinetti ME, Williams CS. Falls, injuries due to falls, and the risk of admission to a nursing home. *N Engl J Med*. 1997;337:1279–1284.
12. Hanmer J, Lu X, Rosenthal GE, Cram P. Insurance status and the transfer of hospitalized patients: an observational study. *Ann Intern Med*. 2014;160:81–90.
13. Centers for Medicare & Medicaid Services. Coverage of extended care (SNF) services under hospital insurance. In: Medicare Benefit Policy Manual. Available at: http://www.cms.gov/Regulations-and-Guidance/Guidance/Manuals/downloads/bp102c08.pdf. Accessed October 3, 2012.
14. Gardner W, Mulvey EP, Shaw EC. Regression analyses of counts and rates: poisson, overdispersed poisson, and negative binomial models. *Psychol Bull*. 1995;118:392–404.
15. Lin RY, Heacock LC, Fogel JF. Drug-induced, dementia-associated and non-dementia, non-drug delirium hospitalizations in the United States, 1998-2005: an analysis of the national inpatient sample. *Drugs Aging*. 2010;27:51–61.
16. Hair JF Jr, Black WC, Babin BJ, Anderson RE. Multiple discriminate analysis and logistic regression. In: *Multivariate Data Analysis*. 7th ed. Upper Saddle River, NJ: Prentice Hall; 2009.
17. Aston G. A growing inpatient imperative: Alzheimer's disease. *Hosp Health Netw*. 2009;83:26, 28, 30.
18. Saver BG, Wang CY, Dobie SA, Green PK, Baldwin LM. The central role of comorbidity in predicting ambulatory care sensitive hospitalizations. *Eur J Public Health*. 2014;24(1):66–72.
19. Agency for Healthcare Research and Quality. Prevention quality indicators technical specifications. Version 4.4. March 2012. Available at: http://www.qualityindicators.ahrq.gov/Archive/PQI_TechSpec_V44.aspx. Accessed September 1, 2012.
20. Givens JL, Selby K, Goldfeld KS, Mitchell SL. Hospital transfers of nursing home residents with advanced dementia. *J Am Geriatr Soc*. 2012;60:905–909.
21. Spector WD, Limcangco R, Williams C, Rhodes W, Hurd D. Potentially Avoidable Hospitalizations for Elderly Long-stay Residents in Nursing Homes. *Med Care*. 2013;51(8):673–681.
22. Centers for Medicare & Medicaid Services. Readmissions reduction program. Available at: http://www.cms.gov/Medicare/Medicare-Fee-for-Service-Payment/AcuteInpatientPPS/Readmissions-Reduction-Program.html. Accessed March 14, 2015.
23. Centers for Medicare & Medicaid Services. Prepayment review demonstration. Available at: http://www.cms.gov/Research-Statistics-Data-and-Systems/Monitoring-Programs/Medicare-FFS-Compliance-Programs/Recovery-Audit-Program/RecoveryAuditPrepaymentReview.html. Accessed September 23, 2014.
24. Report on Medicare Compliance. MS-DRGs targeted in RAC prepayment demo raise red flags despite the delay. Available at: http://www.ehrdocs.com/pdf/news/rmc010912_a.pdf. Accessed September 23, 2014.
25. Centers for Medicare & Medicaid Services. Medicare coverage of skilled nursing facility care. Available at: http://www.medicare.gov/Pubs/pdf/10153.pdf. Accessed March 15, 2015.
26. Mental status change: common complications and conditions in inpatient and surgical care. MCG 18th ed. Available at: http://careweb.careguidelines.com/ed18/index.html. Accessed February 16, 2015.
27. Lin RY, Levine RJ, Scanlan BC. Evolution of end-of-life care at United States hospitals in the new millennium. *J Palliat Med*. 2012;15:592–601.
28. Maslow K, Ouslander JG. Measurement of potentially preventable hospitalizations. white paper prepared for the long term quality alliance. Available at: http://www.ltqa.org/wp-content/themes/ltqaMain/custom/images//PreventableHospitalizations_021512_2.pdf. Published February 2012. Accessed August 6, 2013.