Hospital Characteristics Associated With Feeding Tube Placement in Nursing Home Residents With Advanced Cognitive Impairment

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Context Tube-feeding is of questionable benefit for nursing home residents with advanced dementia. Approximately two-thirds of US nursing home residents who are tube fed had their feeding tube inserted during an acute care hospitalization.

Objective To identify US hospital characteristics associated with higher rates of feeding tube insertion in nursing home residents with advanced cognitive impairment.

Design, Setting, and Patients The sample included nursing home residents aged 66 years or older with advanced cognitive impairment admitted to acute care hospitals between 2000 and 2007. Rate of feeding tube placement was based on a 20% sample of all Medicare Claims files and was assessed in hospitals with at least 30 such admissions during the 8-year period. A multivariable model with the unit of the analysis being the hospital admission identified hospital-level factors independently associated with feeding tube insertion rates, including bed size, ownership, urban location, and medical school affiliation. Measures of each hospital's care practices for all patients with serious chronic illnesses were evaluated, including intensive care unit (ICU) use in the last 6 months of life, the use of hospice services, and the ratio of specialist to primary care physicians. Patient-level characteristics were also considered.

Main Outcome Measure Endoscopic or surgical insertion of a gastrostomy tube during a hospitalization.

Results In 2797 acute care hospitals with 280 869 admissions among 163 022 nursing home residents with advanced cognitive impairment, the rate of feeding tube insertion varied from 0 to 38.9 per 100 hospitalizations (mean [SD], 6.5 [5.3]; median [interquartile range], 5.3 [2.6-9.3]). The mean rate of feeding tube insertions per 100 admissions was 7.9 in 2000, decreasing to 6.2 in 2007. Higher insertion rates were associated with the following hospital features: for-profit ownership vs government owned (8.5 vs 5.5 insertions per 100 hospitalizations; adjusted odds ratio [AOR], 1.33; 95% confidence interval [CI], 1.21-1.46), larger size (>310 beds vs <101 beds: 8.0 vs 4.3 insertions per 100 hospitalizations; AOR, 1.48; 95% CI, 1.35-1.63), and greater ICU use in the last 6 months of life (highest vs lowest decile: 10.1 vs 2.9 insertions per 100 hospitalizations; AOR, 2.60; 95% CI, 2.20-3.06). These differences persisted after controlling for patient characteristics. Specialist to primary care ratio and hospice use were weakly or not associated with feeding tube placement.

Conclusion Among nursing home residents with advanced cognitive impairment admitted to acute care hospitals, for-profit ownership, larger hospital size, and greater ICU use was associated with increased rates of feeding tube insertion, even after adjusting for patient-level characteristics.

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Dementia is now a leading cause of death in the United States, with projection estimates of 16 million individuals having dementia by 2050.[1] The final disease trajectory of dementia is characterized by severe functional impairment, eating problems, malnutrition, and recurrent infections.[2] The decision to place a feeding tube in a patient with advanced dementia is one of the sentinel decisions that family members and health care professionals grapple with in the nursing home environment. Two widely cited structured literature reviews conclude that the use of feeding tubes in patients with advanced dementia does not improve survival, prevent aspiration pneumonia, heal or prevent decubitus ulcers, or improve other clinical outcomes.[3,4] Nevertheless, Mitchell et al[5] report that more than one-third of nursing home residents with advanced dementia have a feeding tube inserted.

Previous studies in this area have focused on identifying variation in feeding tube insertions. Work by multiple investigators has revealed variations in the prevalence or incidence of feeding tube insertions by US state and hospital referral region.[6,7] A recent US study found that more than

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two-thirds of persons with advanced cognitive impairment have their feeding tube inserted during an acute care hospitalization, usually for an infection.[6] As such, acute care hospitals appear to be a key locus for decisions to initiate tube-feeding in this population. Our objective was to show the variation and identify characteristics of acute care hospitals associated with greater rates of feeding tube insertion among patients admitted with advanced cognitive impairment.

METHODS

Study Population

The study population was defined from the 1999-2007 US Nursing Home Minimum Data Set (MDS), which contains federally mandated, quarterly collected data on every resident living in all Medicare-certified or Medicaid-certified US facilities. Resident-level MDS data were then matched to Part A and Part B Carrier Medicare Claims files for a random 20% of all Medicare beneficiaries. A 20% sample was used because the Carrier file, formerly referred to as Part B physician/supplier claims, is at the claim level resulting in a large file size. The use of a random 20% of all beneficiaries means that our absolute values represent approximately one-fifth of the national totals, but the rates are a very good approximation of the national rates.[8]

Inclusion criteria for the study consisted of previously non–tube-fed nursing home residents with advanced cognitive impairment, aged 66 years or older, who were hospitalized between 2000 and 2007. The presence of advanced cognitive impairment was determined using the well-validated Cognitive Performance Score (CPS), defined as a score of 4 or more.[9,10] A total of 295 099 hospitalizations were identified. We excluded 8084 hospitalizations for acute strokes and 494 hospitalizations that were missing information from the MDS on whether there was an order to forgo artificial hydration and nutrition. An additional 5652 hospitalizations were removed because of matching errors in the database. Inclusion of patients with stroke in the analysis did not change the results.

For hospitalized nursing home residents, lack of preexisting feeding tube was confirmed using both Medicare Claims files and MDS assessments. The billing data for that hospitalization based on Part A and Carrier files ascertained whether a procedure was performed to create enteral access for a feeding tube. This was determined by examining Part A and B Medicare Claims data based on the presence of *International Classification of Diseases, Ninth Revision (ICD-9)* procedure codes of 43.11, 43.19, and 44.32, as well as the Current Procedural Terminology, edition 4 (CPT-4) codes of 432.46, 436.53, 437.50, 438.30, 438.32, 443.72, 443.73, and 743.50. The choice of these codes was based on previously published articles,[11,12] a review of the Centers for Medicare & Medicaid Services documentation of changes in *ICD-9* procedure codes during the study period,[13] and documentation of CPT codes maintained by the American Medical Association.[14] See eAppendix documenting our approach and examination of code validity at http://www.jama.com. This research project was approved by the institutional review board of Brown University, Providence, Rhode Island, with waiver of informed consent.

Hospital Characteristics

All acute care hospitals nationwide were eligible for inclusion; however, only those with at least 30 total admissions of nursing home residents with CPS of 4 or higher during the 8-year period were considered in the analysis. Among the 5401 hospitals nationwide, only 2797 met the requirement for at least 30 admissions of nursing home residents with advanced cognitive impairment being included in the 20% Medicare sample. Use of 25 admissions as the cutpoint for inclusion did not affect the study results. Excluded hospitals were more likely to be smaller, rural, and run by the government or with for-profit ownership. Hospital characteristics were obtained from the American Hospital Association Survey data from 2000, 2005, and 2007, the hospital Provider of Service file, and from measures of end-of-life care based on utilizations by Medicare beneficiaries between 2001 and 2005, obtained from the Dartmouth Atlas of Health Care.[8] Specific hospital characteristics evaluated in this analysis included number of hospital beds, ownership status (profit, not-for-profit private, not-for-profit church, or government), graduate medical school residency training approved by the Accreditation Council for Graduate Medical Education, and medical school affiliation. In addition, measures of each hospital's practice patterns in the care of patients with chronic illness were captured by 3 measures from the Dartmouth Atlas of Health Care: (1) intensive care utilization in last 6 months of life among all patients who had underlying serious chronic illness, (2) ratio of specialist to primary care full-time equivalent per 1000 decedents, and (3) the use of hospice services. An a priori decision was made to operationalize these latter 3 independent measures into deciles.

Nursing Home Resident Characteristics

The selection of resident characteristics to adjust for potential differences in disease severity and sociodemographic characteristics was based on a review of the literature.[5,12,15-19] Selected characteristics included sociodemographic characteristics (age, sex, race), previously diagnosed medical illnesses, written advance directives, orders to forgo life-sustaining treatment (resuscitation and artificial hydration and nutrition), and patient functioning (CPS and 28-point measure of the activities of daily living). Race/ethnicity was included because past studies demonstrated differences in feeding tube placement by race/ethnicity and was classified based on the MDS completed by staff in a nursing home. Because of the small number of Asians, Pacific Islanders, and American Indians, we collapsed these race/ethnicity categories into a single category of "other." Age was coded into accepted cutoffs of 66 to 79 years, 80 to 84 years, 85 to 89 years, and 90 years or

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Table 1. Change in Numbers of Feeding Tube Insertions in Nursing Home Residents With Advanced Cognitive Impairment in US Hospitals Between 2000 and 2007

Year	No. of Hospitals[a]	No. of Admissions[b]	No. of Feeding Tube Insertions per Hospital, Mean (SD)[b]	Feeding Tube Insertions per 100 Hospital Admissions, Mean (95% CI)
2000	2699	34 739	1.0 (1.5)	7.9 (7.6-8.2)
2001	2741	36 128	1.0 (1.6)	7.8 (7.6-8.1)
2002	2755	37 124	0.98 (1.5)	7.3 (7.0-7.6)
2003	2756	37 548	0.98 (1.5)	7.2 (6.9-7.5)
2004	2733	36 161	0.89 (1.5)	6.8 (6.5-7.0)
2005	2697	36 381	0.89 (1.5)	6.6 (6.4-6.9)
2006	2612	34 383	0.85 (1.4)	6.5 (6.2-6.7)
2007	2567	28 405	0.69 (1.2)	6.2 (5.9-6.5)

Abbreviation: CI, confidence interval.
[a] A total of 2797 hospitals had at least 30 admissions of nursing home residents with a Cognitive Performance Score of 4 or more. The number of hospitals varies by year because some hospitals may not have had any of these type of admissions in the particular year and some hospitals closed or merged over time.
[b] The number of admissions and mean number of feeding tube insertions per hospital is based on the random 20% sample Medicare Carrier file. To estimate the national total number of admissions and feeding tube insertions, multiply by 5.

older. Because the selected cognitively impaired population of nursing home residents was already functionally impaired, we operationalized the 0 to 28 activities of daily living score as being severely functionally impaired (ie, a score of 28) vs all other scores.

Statistical Analyses

A multivariable logistic model with random effects allowed for a random intercept for each hospital. The unit of analysis was the hospital admission. The analysis included all hospital admissions for nursing home residents without a feeding tube who met the defined eligibility criteria. All admissions after the first feeding tube insertion were censored. Robust SEs were used to adjust for clustering of admissions within hospitals. Two models were fitted. The first model examined only hospital-level characteristics, and the second model examined the association of hospital-level characteristics after adjustment for patient-level characteristics listed above, the number of days between the MDS assessment and hospital admission, the number of hospitalizations, and the year of hospital admission. Models were estimated in STATA version 10 (StataCorp LP, College Station, Texas) using the *xtlogit* command with the random effect option. Additionally, sensitivity analyses were performed estimating the model with the hospital as the unit of analysis and the rate of feeding tube insertion as the outcome using a fractional logit multivariable model, which yielded similar results and conclusions. Hypothesis tests were 2-sided using a 5% significance level with 95% confidence intervals (CIs) reported.

RESULTS

A total of 2797 acute care hospitals had at least 30 total admissions of nursing home residents with advanced cognitive impairment defined as a CPS of at least 4 from among the 20% Medicare beneficiary sample. Between 2000 and 2007, 280 869 admissions occurred among 163 022 nursing home residents (mean [SD] age, 84.0 [7.5] years; 66.6% women, and 12.5% black residents). A total of 19 847 feeding tube insertions occurred, of which 94.7% were percutaneous endoscopic gastrostomy feeding tubes. Because our analytic sample is based on a 20% random sample of Medicare beneficiaries, national estimates of the number of admissions, nursing home residents, and feeding tube insertions can be calculated as the absolute numbers multiplied by 5. During the 8-year period, the hospital rate of feeding tube insertion per 100 eligible admissions decreased (TABLE 1), from a high of 7.9 in 2000 (95% CI, 7.6-8.2) to a low of 6.2 in 2007 (95% CI, 5.9-6.5). Most of this decrease occurred before 2005. TABLE 2 shows the characteristics of these hospitals. The mean number of beds was 235 (median [interquartile range {IQR}], 184 [101-311]); 18.5% were for profit and 30.8% had a medical school affiliation.

The rate of feeding tube insertion varied from 0 to 38.9 per 100 hospitalizations (mean [SD], 6.5 [5.3]; median [IQR], 5.3 [2.6-9.3]). Of the 2797 hospitals with at least 30 total admissions for a nursing home resident with advanced cognitive impairment, 335 (12.0%) of the hospitals did not insert any feeding tubes. These hospitals tended to be smaller (59.2% had fewer than 101 hospital beds vs 20.0% among those hospitals with feeding tube insertions), were more likely to be located in rural regions (54.8% vs 25.3%), and were less likely to be affiliated with a medical school (16.4% vs 32.8%). Furthermore, these institutions represented 34.1% of those hospitals in the lowest decile of intensive care unit (ICU) utilizations for decedents with chronic illnesses that use that hospital.

Table 2 shows the rates of unadjusted feeding tube insertions per 100 hospital admissions and the results of 2 multivariable logistic models with the unit of analysis being the hospital admission. The results of the first model are adjusted for only hospital characteristics (Table 2), and the second model (Table 2) examines whether these associations persist after adjustment for nursing home resident characteristics listed in TABLE 3. In general, the inclusion of nursing home resident characteristics slightly attenuated the magnitude of the observed hospital characteristic associations.

In the multivariable analyses, nursing home residents with advanced cognitive impairment admitted to hospitals with greater ICU utilization for decedents with chronic illness in the last 6 months of life were more likely to have a feeding tube inserted. The absolute difference between the highest and lowest decile of ICU utilization was 7.2 feeding tube insertions per 100 hospital

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Table 2. Hospital Characteristics Associated With Feeding Tube Insertion Adjusted for Patient Characteristics

Characteristics	No. (%) Hospitals (n = 2797)	No. (%) Hospital Admissions (n = 280 869)	No. (%) Feeding Tube Insertions (n = 19 847)	Unadjusted Feeding Tube Insertion Rate per 100 Admissions (95% CI)	Feeding Tube Insertions, AOR (95% CI) With Hospital Characteristics Only (n = 275 410)	Feeding Tube Insertions, AOR (95% CI) With Hospital and Patient Characteristics (n = 275 410)[a]
Ownership						
Government	416 (14.9)	31 744 (11.3)	1734 (8.7)	5.5 (5.2-5.7)	1 [Reference]	1 [Reference]
Not-for-profit private	1478 (52.8)	161 989 (57.7)	11 803 (59.5)	6.8 (6.7-7.0)	1.06 (.97-1.16)	1.15 (1.06-1.25)
For profit	518 (18.5)	45 041 (16.0)	3846 (19.3)	8.5 (8.3-8.8)	1.33 (1.20-1.48)	1.33 (1.21-1.46)
Not-for-profit church	383 (13.7)	42 031 (15.0)	3183 (16.0)	7.6 (7.3-7.8)	1.16 (1.04-1.30)	1.29 (1.16-1.42)
No. of beds						
<101	692 (24.7)	39 487 (14.1)	1711 (8.6)	4.3 (4.1-4.5)	1 [Reference]	1 [Reference]
101-182	701 (25.1)	55 708 (19.8)	3715 (18.7)	6.7 (6.5-6.9)	1.42 (1.29-1.56)	1.40 (1.29-1.53)
183-310	702 (25.1)	78 209 (27.8)	5820 (29.3)	7.4 (7.2-7.6)	1.52 (1.38-1.67)	1.48 (1.36-1.62)
>310	702 (25.1)	107 465 (38.3)	8601 (43.3)	8.0 (7.8-8.2)	1.57 (1.42-1.75)	1.48 (1.35-1.63)
Medical school affiliation	862 (30.8)	109 710 (39.1)	8343 (42.0)	7.6 (7.4-7.8)	0.88 (0.80-0.96)	0.90 (0.83-0.98)
Accredited for GME	666 (23.8)	81 966 (29.2)	6597 (33.2)	8.0 (7.9-8.2)	1.24 (1.12-1.37)	1.10 (1.01-1.20)
Urban location	1990 (71.2)	225 813 (80.4)	17 236 (86.8)	7.6 (7.5-7.7)	1.13 (1.04-1.23)	1.16 (1.07-1.25)
ICU use among decedents with chronic illness that used that hospital[a]						
Lowest decile	267 (10.0)	18 372 (6.70	541 (2.8)	2.9 (2.7-3.2)	1 [Reference]	1 [Reference]
2nd decile	268 (10.0)	21 992 (8.0)	1135 (5.8)	5.2 (4.9-5.4)	1.71 (1.47-2.00)	1.53 (1.33-1.77)
3rd decile	266 (9.9)	27 684 (10.1)	1332 (6.8)	4.8 (4.6-5.1)	1.53 (1.30-1.80)	1.38 (1.19-1.61)
4th decile	269 (10.0)	24 460 (8.9)	1727 (8.8)	7.1 (6.7-7.4)	2.30 (1.96-2.70)	1.94 (1.67-2.24)
5th decile	250 (9.3)	22 694 (8.2)	1376 (7.0)	6.1 (5.7-6.4)	2.12 (1.81-2.51)	1.77 (1.52-2.05)
6th decile	286 (10.7)	30 430 (11.1)	1921 (9.8)	6.3 (6.0-6.6)	1.94 (1.65-2.28)	1.60 (1.38-1.85)
7th decile	265 (9.9)	29 944 (10.9)	2089 (10.7)	7.0 (6.7-7.2)	2.23 (1.90-2.62)	1.76 (1.52-2.05)
8th decile	268 (10.0)	36 226 (13.2)	3405 (17.4)	9.4 (9.1-9.7)	2.77 (2.34-3.27)	2.04 (1.75-2.38)
9th decile	269 (10.0)	28 340 (10.3)	2440 (12.5)	8.6 (8.3-8.9)	3.00 (2.52-3.55)	2.23 (1.90-2.60)
Highest decile	271 (10.1)	35 268 (12.8)	3570 (18.3)	10.1 (9.8-10.4)	3.62 (3.02-4.34)	2.60 (2.20-3.06)
Specialist to primary care physician ratio per 1000 decedents[a]						
Lowest decile	264 (9.8)	19 640 (7.1)	698 (3.6)	3.6 (3.3-3.8)	1 [Reference]	1 [Reference]
2nd decile	238 (8.9)	21 992 (8.0)	1449 (7.4)	6.6 (6.2-6.9)	1.23 (1.05-1.45)	1.08 (0.93-1.25)
3rd decile	296 (11.1)	26 377 (9.6)	1537 (7.9)	5.8 (5.5-6.1)	1.15 (0.99-1.35)	1.01 (0.88-1.16)
4th decile	240 (9.0)	25 200 (9.2)	1392 (7.1)	5.5 (5.2-5.8)	1.29 (1.09-1.52)	1.16 (1.00-1.35)
5th decile	296 (11.1)	28 828 (10.5)	2075 (10.6)	7.2 (6.6-7.9)	1.36 (1.16-1.59)	1.18 (1.03-1.37)
6th decile	239 (8.9)	31 810 (11.6)	2892 (14.8)	9.1 (8.8-9.4)	1.48 (1.27-1.73)	1.25 (1.09-1.44)
7th decile	302 (11.3)	29 054 (10.6)	2020 (10.3)	6.9 (6.7-7.2)	1.18 (1.00-1.39)	1.10 (0.95-1.27)
8th decile	265 (9.9)	28 749 (10.4)	1851 (9.5)	6.4 (6.2-6.7)	1.03 (0.87-1.21)	0.98 (0.84-1.14)
9th decile	227 (8.5)	26 952 (9.8)	2321 (11.9)	8.6 (8.3-8.9)	1.16 (0.97-1.38)	1.04 (0.89-1.22)
Highest decile	312 (11.7)	36 808 (13.4)	3301 (16.9)	9.0 (8.7-9.3)	1.10 (0.92-1.31)	0.97 (0.83-1.13)
Hospice use among decedents with chronic illness that used that hospital[a]						
Lowest decile	257 (9.6)	32 453 (11.8)	2848 (14.6)	8.8 (8.5-9.1)	1 [Reference]	1 [Reference]
2nd decile	276 (10.3)	27 536 (10.0)	2199 (11.3)	8.0 (7.7-8.3)	1.09 (0.94-1.26)	1.06 (0.93-1.20)
3rd decile	265 (9.9)	29 551 (10.7)	1684 (8.6)	5.7 (5.4-6.0)	0.87 (0.75-1.00)	0.84 (0.74-0.95)
4th decile	265 (9.9)	25 997 (9.4)	1690 (8.6)	6.5 (6.2-6.7)	0.83 (0.73-0.95)	0.84 (0.75-0.95)
5th decile	274 (10.2)	30 386 (11.0)	1866 (9.6)	6.1 (5.9-6.4)	0.87 (0.75-1.00)	0.87 (0.76-0.99)
6th decile	268 (10.0)	25 523 (9.3)	1753 (9.0)	6.9 (6.6-7.2)	1.06 (0.92-1.23)	0.99 (0.87-1.13)
7th decile	269 (10.0)	26 722 (9.7)	2090 (10.7)	7.8 (7.5-8.1)	1.07 (0.93-1.23)	0.95 (0.84-1.08)
8th decile	268 (10.0)	26 017 (9.5)	1913 (9.8)	7.4 (7.0-7.7)	0.98 (0.85-1.12)	0.95 (0.84-1.08)
9th decile	242 (9.0)	25 993 (9.4)	1751 (9.0)	6.7 (6.4-7.0)	0.91 (0.79-1.05)	0.91 (0.81-1.04)
Highest decile	295 (11.0)	25 232 (9.2)	1742 (8.9)	6.9 (6.6-7.2)	1.10 (0.96-1.27)	1.01 (0.89-1.15)

Abbreviations: AOR, adjusted odds ratio; CI, confidence interval; GME, graduate medical education; ICU, intensive care unit.

[a] Data from the Dartmouth Atlas of Health Care were available for 2679 of 2797 hospitals, resulting in 5459 missing hospital admissions. The final model adjusted for the year of admission, the number of days between the 1999-2007 Nursing Home Minimum Data Set assessment and hospital admission, and number of previous hospital admissions, plus the patient characteristics of age, sex, race/ethnicity, medical history, advance directives, durable power of attorney for health care, written orders to forgo life-sustaining treatment, and cognitive performance status and activities of daily living score indicating severe impairment.

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admissions (fully adjusted odds ratio (AOR), 2.60; 95% CI, 2.20-3.06). A higher rate of feeding tube insertions also was independently associated with for-profit ownership vs hospitals owned by state or local government, with an absolute difference of 3.0 feeding tube insertions per 100 admissions (AOR, 1.33; 95% CI, 1.21-1.46). Hospitals with a greater number of beds (>310 beds vs <101 beds: AOR, 1.48; 95% CI, 1.35-1.63) also had higher rates of feeding tube insertion. The ratio of specialist to primary care full-time equivalent per 1000 decedents did not exhibit the hypothesized trend that a higher ratio was associated with a higher feeding tube use. Instead, nursing home residents admitted to hospitals in the fourth, fifth, and sixth deciles of this ratio had a somewhat higher feeding tube insertion rate. Hospitals accredited for graduate medical education had a slightly higher rate of feeding tube insertions (AOR, 1.10; 95% CI, 1.01-1.20). Medical school affiliation and hospital use of hospice services among persons with chronic illnesses who died were not strongly associated with feeding tube insertion rates.

Several nursing home resident characteristics were independently associated with feeding tube use (Table 3). White residents had the lowest likelihood of feeding tube insertion, while black residents experienced nearly a 2-fold increase in the likelihood of feeding tube insertion (AOR, 1.96; 95% CI, 1.89-2.04). The absolute difference in the rate of feeding tube insertions per 100 hospital admissions between white and black residents was 8.5. Written advance directives, do not resuscitate orders, and orders to forgo artificial hydration and nutrition were indepen-

Table 3. Individual Characteristics of Nursing Home Residents With Advanced Cognitive Impairment Associated With Feeding Tube Insertion

Characteristics	No. (%) Admissions (n = 280 869)	No. (%) Feeding Tube Insertions (n = 19 847)	Unadjusted Feeding Tube Insertion Rate per 100 Admissions (95% CI)	Feeding Tube Insertion With Hospital and Patient Characteristics, AOR (95% CI) (n = 275 410)[a]
Sex				
Men	95 260 (33.9)	7365 (37.1)	7.7 (7.6-7.9)	1 [Reference]
Women	185 585 (66.1)	12 482 (62.9)	6.7 (6.7-6.8)	0.88 (0.85-0.91)
Race/ethnicity[b]				
White	222 832 (79.4)	12 215 (61.6)	5.5 (5.4-5.6)	1 [Reference]
Black	39 716 (14.2)	5593 (28.2)	14.0 (13.7-14.4)	1.96 (1.89-2.04)
Hispanic	13 509 (4.8)	1556 (7.9)	11.5 (11.0-12.1)	1.36 (1.27-1.46)
Other	4507 (1.6)	461 (2.3)	10.2 (9.3-11.1)	1.42 (1.28-1.59)
Age, y				
66-79	81 600 (29.1)	6537 (32.9)	8.0 (7.8-8.2)	1 [Reference]
80-84	66 739 (23.8)	47 770 (24.0)	7.1 (6.9-7.3)	1.00 (0.96-1.04)
85-89	69 729 (24.8)	4686 (23.6)	6.7 (6.5-6.9)	1.00 (0.95-1.04)
≥90	62 801 (22.4)	3854 (19.4)	6.1 (5.9-6.3)	0.90 (0.86-0.94)
Medical history				
Cancer	11 471 (4.1)	736 (3.7)	6.4 (6.0-6.9)	0.86 (0.79-0.93)
COPD	39 226 (14.0)	2469 (12.4)	6.3 (6.0-6.5)	0.89 (0.85-0.93)
Stroke	70 567 (25.1)	5840 (29.4)	8.3 (8.1-8.5)	1.16 (1.12-1.20)
Hip fracture	19 785 (7.0)	1263 (6.4)	6.4 (6.0-6.7)	1.00 (0.94-1.06)
Advance directives				
Living will	35 609 (12.7)	1447 (7.3)	4.1 (3.9-4.3)	0.75 (0.70-0.79)
Durable power of attorney for health care	79 408 (28.3)	3753 (18.9)	4.7 (4.6-4.9)	0.88 (0.84-0.91)
Written orders to forgo life-sustaining treatment				
Do not resuscitate	131 235 (46.7)	6102 (30.8)	4.6 (4.5-4.7)	0.65 (0.62-0.67)
Orders to forgo artificial hydration and nutrition	16 276 (5.8)	590 (3.0)	3.6 (3.3-3.9)	0.73 (0.67-0.80)
Cognitive Performance Score status				
4	122 161 (43.5)	7987 (40.2)	6.5 (6.3-6.7)	1 [Reference]
5	94 605 (33.7)	4922 (24.8)	5.2 (5.1-5.3)	0.96 (0.92-0.99)
6	64 103 (22.8)	6938 (35.0)	10.8 (10.6-11.1)	1.57 (1.51-1.64)
ADL score indicating severe impairment[b]	51 503 (18.3)	5905 (29.8)	11.5 (11.1-11.7)	1.43 (1.37-1.50)

Abbreviations: ADL, activities of daily living; AOR, adjusted odds ratio; CI, confidence interval; COPD, chronic obstructive pulmonary disease.
[a] Data from the Dartmouth Atlas of Health Care were available for 2679 of 2797 hospitals, resulting in 5459 missing hospital admissions. The model adjusted for hospital characteristics listed in Table 2 as well year of admission, the number of days between the 1999-2007 Nursing Home Minimum Data Set assessment and hospital admission, and number of previous hospital admissions.
[b] See "Methods" section for definitions.

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dently associated with lower likelihood of feeding tube insertion.

COMMENT

Feeding tube insertion in persons with advanced cognitive impairment demonstrates a disconnect with the existing evidence of their effectiveness. Two widely cited qualitative literature reviews[3,4] have questioned the effectiveness of feeding tubes in persons with advanced dementia, citing a lack of evidence for improved survival, pressure ulcer resolution, or the prevention of aspiration pneumonia. Nevertheless, among US hospitals with at least 30 admissions of persons with advanced cognitive impairment during the 8-year period, the rate of feeding tube insertions varied widely from 0 to 38.9 insertions per 100 admissions. Our research findings call for multifaceted interventions to ensure that the insertion of feeding tubes during acute care hospitalizations is consistent with patient preferences after thorough discussion of the risks and benefits.

Hospital characteristics associated with higher rates of feeding tube insertion include larger size, for profit, and more ICU days for decedents with chronic illnesses during the last 6 months of life. Levels of specialty care and hospice care were weakly or not associated with rates of feeding tube insertion. Our findings that larger and for-profit hospitals were more likely to insert feeding tubes is consistent with the examination of end-of-life care intensity in Pennsylvania by Lin et al.[20] Nevertheless, the reason for these associations are not known and future research is needed to understand these associations. Higher rates of ICU use for chronically ill patients during the last 6 months of life also were significantly associated with feeding tube insertion rates, even after controlling for other hospital and nursing home resident characteristics.

As reported by other studies,[5,12,18,19] black and Hispanic residents were more likely to undergo a feeding tube insertion. Further research is needed to understand whether this reflects informed preferences for more aggressive care at the end of life, a disparity in physician communication, or that minorities receive their health care at hospitals, nursing homes, or both that provide a disproportionate amount of care for indigent patients that potentially affects staffing ratios and quality of care.[21] Our results confirm that written advance directives, do not resuscitate orders, and orders to forgo artificial hydration and nutrition are associated with lower rates of feeding tube insertions, suggesting that advance care planning has an important role in the reduction of potentially unnecessary procedures.

These results raise more questions than answers, but determining variation in characteristics associated with insertion of feeding tubes is an important first step. A full report of hospital rates of feeding tube insertions is available at http://www.LTCFocus.org. Future research to examine these reported variations should focus on decision making for feeding tube insertion in hospitalized nursing home residents with dementia. Additionally, the role that hospitals and nursing homes have in advance care planning is critically important. Advance care planning is often lacking in nursing homes.[22,23] Table 3 shows that only 5.8% of hospitalized nursing home residents with advanced cognitive impairment had an order to forgo artificial hydration and nutrition despite the finding of O'Brien et al[24] that most nursing home residents would "rather die" than live in a state of advanced dementia with a feeding tube. Improving advance care planning is essential to ensure that feeding tube insertions are based on informed patient preferences.[25,26]

Our study has several limitations. With the exception of orders noted in the MDS to forgo artificial hydration and nutrition, information on physician counseling and patient preferences regarding feeding tube insertion is lacking. We relied on both *ICD-9* and CPT procedure codes from billing data to indicate whether a feeding tube was placed. These data as well as the MDS may include some inaccuracies. Our analytic files relied on hospitalizations between 2000 and 2007. Rates of feeding tube insertion decreased during the study period and it is possible that rates have changed further, although most of the decrease observed occurred by 2005.

CONCLUSION

Eating problems represent an important issue for individuals with advanced cognitive impairment and many experts have expressed concerns regarding the overuse of feeding tubes. Studies have suggested that more than one-third of nursing home residents with advanced cognitive impairment have feeding tubes inserted and the majority of these tubes are placed during acute care hospitalizations. These results are the first to our knowledge to document the national variation in rates of feeding tube insertions among acute care hospitals. Future research is needed to better understand why this variation occurs and to intervene to ensure that feeding tube insertion reflects informed patient preferences based on discussion of the evidence of risks vs benefits.

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