*Original Article*

# Do Patients With Advanced Cognitive Impairment Admitted to Hospitals With Higher Rates of Feeding Tube Insertion Have Improved Survival?

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## Abstract

**Context.** Research is conflicting on whether receiving medical care at a hospital with more aggressive treatment patterns improves survival.

**Objectives.** The aim of this study was to examine whether nursing home residents admitted to hospitals with more aggressive patterns of feeding tube insertion had improved survival.

**Methods.** Using the 1999–2007 Minimum Data Set matched to Medicare claims, we identified hospitalized nursing home residents with advanced cognitive impairment who did not have a feeding tube inserted prior to their hospital admissions. The sample included 56,824 nursing home residents and 1773 acute care hospitals nationwide. Hospitals were categorized into nine groups based on feeding tube insertion rates and whether the rates were increasing, staying the same, or decreasing between the periods of 2000–2003 and 2004–2007. Multivariate logit models were used to examine the association between the hospital patterns of feeding tube insertion and survival among hospitalized nursing home residents with advanced cognitive impairment.

**Results.** Nearly one in five hospitals ($N = 366$) had persistently high rates of feeding tube insertion. Being admitted to these hospitals with persistently high rates of feeding tube insertion was not associated with improved survival when compared with being admitted to hospitals with persistently low rates of feeding tube insertion. The adjusted odds ratios were 0.93 (95% confidence interval [CI]:

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0.87, 1.01) and 1.02 (95% CI: 0.95, 1.09) for one month and six month posthospitalization survival, respectively.

**Conclusion.** Hospitals with more aggressive patterns of feeding tube insertion did not have improved survival for hospitalized nursing home residents with advanced cognitive impairment. J Pain Symptom Manage 2012;■:■−■. © *2012 U.S. Cancer Pain Relief Committee. Published by Elsevier Inc. All rights reserved.*

***Key Words***
*Feeding tube, survival, advanced cognitive impairment*

## *Introduction*

Dementia is a leading cause of death in the United States.[1] The majority of persons with advance dementia will develop eating problems at the final stage of dementia. Feeding tubes are widely used in this population,[2,3] although research based on observational data questions the benefits of feeding tube use for these patients.[4−13] For example, feeding tube insertion among patients with advanced dementia has not been shown to be related to improve survival or prevention of aspiration pneumonia or pressure ulcers.[14,15]

Hospitals are usually the locus of feeding tube insertion.[13] Yet, the rates of feeding tube insertion among patients with advanced cognitive impairment vary by hospital from 0% to 38.9%.[16] However, it is not clear how this hospital level variation in feeding tube insertion—a marker of more aggressive treatment practices—impacts the survival of patients with advanced cognitive impairment. Previous research on the association between a hospital's treatment intensity and patient outcomes is inconclusive. Being admitted to a hospital with higher treatment intensity has not been found to be associated with improved survival or higher ratings of the quality of care.[17−19] However, two recent studies question these findings. Ong et al.[20] found that six California hospitals with higher end-of-life care spending had lower mortality. Similarly, Silber et al.[21] reported that a more aggressive treatment style was associated with a lower surgical mortality rate. None of these studies are specifically focused on people with advanced cognitive impairment. Thus, our goal was to examine whether being admitted to a hospital with a higher rate of feeding tube insertion is associated with improved survival for nursing home residents with advanced cognitive impairment. This study uses multiple national data sources that provide us with a large sample and detailed information about individuals' medical conditions, and hospital and nursing home characteristics.

## *Methods*

### *Sample*

Our sample of hospitalized nursing home residents with advanced cognitive impairment was based on the Minimum Data Set (MDS) matched to the Medicare claims from 1999 to 2007. The MDS is a federally mandated assessment tool for all Medicare-/Medicaid-certified nursing homes and contains residents' sociodemographic information and their detailed health conditions. The Medicare denominator file includes Medicare enrollment and demographic information (e.g., date of death) for all the Medicare beneficiaries. The Medicare Inpatient Part A file contains hospitalization records, such as admission dates and diagnoses for all the Medicare fee-for-service (FFS) beneficiaries. The Medicare Part B file is a 20% random sample of all Medicare FFS beneficiaries with information about the procedures performed in an outpatient setting. We identified the nursing home residents as individuals 66 years or older who had severe cognitive impairment—that is, they had a cognitive performance score (CPS) of four or higher (a 0−6 scale based on the MDS).[22,23] We used CPS rather than the diagnosis of dementia to identify the cohort because dementia diagnosis could be underreported in the MDS (the diagnosis section was based on physician documentation of medical diagnosis, whereas the CPS score was based on nursing home staff

assessment). We excluded residents who had a percutaneous endoscopic gastronomic (PEG) feeding tube inserted prior to their hospital admission from January 1, 2000 to December 31, 2007. We used a look-back period of at least one year to track previous tube insertions. Data from 1999 were used to identify any prior tube insertions for those who were hospitalized in 2000. Nursing home residents who were admitted to different hospitals between 2004 and 2007 were excluded because the outcomes of their care could have been affected by more than one hospital (this excluded 19% of nursing home residents). We used the first hospital admission (regardless of whether or not the patient received a feeding tube insertion in the hospital) if individuals had one or more admissions to the same hospital during 2004–2007. As in prior work,[16] PEG feeding tube insertions were defined from Medicare Part A and Part B claims containing the ICD-9 procedure codes (43.11, 43.19, and 44.32) or the CPT-4 codes (43246, 43653, 43750, 43830, 43832, 44372, 44373, and 74350). We selected hospitals with at least 25 admissions from qualified nursing home residents in both 2000–2003 and 2004–2007 periods. The final sample included 1773 hospitals and 56,824 nursing home residents for assessing mortality throughout 2004–2007.

*Outcomes and Independent Variables*

The outcomes of interest were one month and six month individual mortality after the index hospital admission in 2004–2007. The key independent variable was hospital patterns of feeding tube use, as measured by tertiles of feeding tube insertion rates calculated among cohort members from 2000 to 2003 and 2004 to 2007. Because hospitals with recent changes in their levels of aggressiveness of feeding tube insertion may differ from those without such changes, we classified hospitals based on their rates of tube insertion during an earlier period (2000–2003), as well as the analysis period (2004–2007), into nine groups of hospitals that accounted for both their current level of aggressiveness, as well as its persistence over time.

Specifically, we calculated the average rate of tube insertion among cohort members (hospitalized nursing home residents with advanced cognitive impairment) admitted to each hospital during 2000–2003 and 2004–2007, respectively, with feeding tube insertions identified as described above. For each time period, hospitals were grouped into tertiles—"high" (top 1/3), "medium" (middle 1/3) and "low" (bottom 1/3)—based on their rates of feeding tube insertion. Rankings across the two periods were combined to yield nine categories: "low-low;" "low-medium;" "low-high;" "medium-low;" "medium-medium;" "medium-high;" "high-low;" "high-medium;" and "high-high." We were most interested in hospitals at the ends of the spectrum either persistently low or high rates of feeding tube insertion, as we would expect that any survival benefit would be in the hospitals with persistently high rates of feeding tube insertion when compared with those hospitals with persistently low rates of feeding tube insertion.

Other independent variables were included to adjust for potential confounders between hospital feeding tube insertion and subsequent mortality at the individual, nursing home, and acute care hospital levels. At the individual level, we first adjusted for principal diagnosis of hospital admissions, according to the ICD-9 codes in inpatient claims. We identified the nine most common disease diagnoses and grouped all the other diagnoses. Based on a review of the literature,[8,24] we also included other individual variables to account for potential differences in health conditions and sociodemographic characteristics of nursing home residents across the nine groups of hospitals. Sociodemographic characteristics included age, gender, marital status, and race. Health condition measures were taken from the MDS and included comorbidities (e.g. diabetes, stroke), activities of daily living (ADL) score, CPS score, and the Changes in Health, End-Stage Disease and Symptoms and Signs (CHESS) score.[25] The ADL score is measured between 0 and 28, with the latter indicating severe functional impairment.[26] Because this population was severely cognitively (i.e., CPS 4–6 by cohort definition) and functionally impaired, we coded this measure as an indicator of having an ADL score of 28 vs. all other scores. The CHESS scale is a measure of likelihood of mortality, ranging from 0 to 5, with higher scores indicating higher risk of death.[25] Lastly, we also included variables to indicate whether there were written physician orders to limit

treatments (e.g., do-not-resuscitate order, written order to limit the insertion of feeding tubes), and whether the nursing home residents had a legal guardian appointed to make decisions for them. All of these measures were taken from the last MDS assessment performed prior to the index hospital admission. Additional covariates included the time interval between the MDS assessment and the hospital admission, as well as the calendar year of the index hospitalization, to account for any potential secular trends in mortality because survival was examined over a four year period.

Characteristics of nursing homes may be associated with the severity of individual health conditions at the time of hospitalization.[27,28] Therefore, we controlled for selected nursing home characteristics, such as ownership (for profit vs. not for profit) and chain membership.[27,29,30] Finally, organizational characteristics of the hospital[16]—such as ownership (for profit vs. not for profit), location (urban vs. rural), and hospice days per decedent during end-of-life care—were obtained from the American Hospital Association and Dartmouth Atlas data.[31]

### *Statistical Analysis*

We used three-level logistic regression models (to account for correlations within nursing homes and within hospitals) to examine one month and six month mortality following the index hospital admission. We estimated two types of regression models to illustrate changes in the adjusted odds ratios (AOR) of mortality using different sets of independent variables (e.g., age, gender, other demographic variables, advance directives, health conditions, and hospital characteristics). In this way, we examined how the inclusion of different control variables modified the relationship between hospital feeding tube insertion patterns and individual mortality. Specifically, Model 1 included the main predictor identifying the aggressiveness of hospital feeding tube use (as a set of nominal categorical variables) adjusting for a year trend, whereas Model 2 added individual, nursing home (from where the resident was hospitalized), and additional hospital characteristics. We also determined whether the odds of mortality associated with hospital rates of feeding tube insertion were statistically different from each other among the nine categories of hospitals.

To check the robustness of our findings, we performed a sensitivity analysis comparing hospitals from the most extreme groups of feeding tube insertions—hospitals with "extremely" low rates of feeding tube insertion (i.e., the lowest deciles of hospital feeding tube insertion rates in both 2000–2003 and 2004–2007) and hospitals with "extremely" high rates of feeding tube insertions (i.e., the highest deciles of hospital feeding tube insertion rates in both 2000–2003 and 2004–2007). The sample size for the sensitivity analysis included 3696 individuals and 149 hospitals.

Models were estimated using Stata 11.0 (StataCorp LP, College Station, TX). This study was approved by the Institutional Review Board of Brown University.

## *Results*

### *Sample Description*

As shown in Table 1, among the 1773 hospitals, 18.5% ($n = 328$) had persistently low rates of tube insertion (i.e., were in the lowest tertile in both time periods, the "low-low" group), whereas 20.6% ($n = 366$) had persistently high rates (i.e., were in the highest tertile in both time periods, the "high-high" group) over the period of 2000–2007. Overall, slightly more than one-half (52%, $n = 922$) of all hospitals were stable in their tertile ranking of feeding tube insertion rates (i.e., "low-low," "medium-medium," and "high-high") over time. Also, average tube insertion rates in "low-low" hospitals were lower than 2% of admissions during both periods when compared with "high-high" hospitals, which had average tube insertion rates of 14.7% of admissions in 2000–2003 and 13.1% of admissions in 2004–2007.

### *Association of Individual and Hospital Characteristics With Variation in the Rates of Feeding Tube Insertion*

Nine categories were formed based on the rates of feeding tube insertion in the hospital in the two time periods (2000–2003 and 2004–2007). Table 2 describes the variations of individual and hospital characteristics across these nine groups of hospitals. The findings confirm the previously reported association

*Table 1*
**Feeding Tube Insertion Rates Among the Nine Groups of Hospitals ($N = 1773$)**

| Groups of Hospitals | No. of Hospitals in Each Group *n* (%) | No. of Feeding Tube Insertions per 100 Hospital Admissions During 2000–2003 Mean (SD) | No. of Feeding Tube Insertions per 100 Hospital Admissions During 2004–2007 Mean (SD) |
|---|---|---|---|
| Group 1: low-low | 328 (18.50) | 1.82 (1.54) | 1.23 (1.28) |
| Group 2: low-med | 207 (11.68) | 2.21 (1.44) | 5.05 (1.20) |
| Group 3: low-high | 62 (3.50) | 2.58 (1.50) | 10.97 (3.48) |
| Group 4: med-low | 199 (11.22) | 6.33 (1.20) | 1.59 (1.16) |
| Group 5: med-med | 228 (12.86) | 6.60 (1.20) | 5.48 (1.27) |
| Group 6: med-high | 159 (8.97) | 6.82 (1.34) | 11.44 (3.90) |
| Group 7: high-low | 70 (3.95) | 12.20 (2.98) | 1.7 (1.20) |
| Group 8: high-med | 154 (8.69) | 12.61 (3.20) | 5.79 (1.14) |
| Group 9: high-high | 366 (20.64) | 14.73 (4.68) | 13.09 (4.72) |

of individual and hospital characteristics with the risks of feeding tube insertion.[16] For example, only 5.3% of the individuals were African Americans in hospitals with persistently low rates of feeding tube insertion when compared with 24.1% in hospitals with persistently high rates of feeding tube insertion. As previously reported,[16] do-not-resuscitate orders and orders to restrict the use of feeding tubes were different among hospitals with different patterns of feeding tube insertion. When compared with hospitals that had persistently lower rates of feeding tube insertion, hospitals with persistently higher insertion rates were more likely to be for profit and located in urban areas.

### *Variation in Hospital Feeding Tube Insertion Rates and Mortality*

Among the cohort members, 29.5% died within one month of the index hospitalization, and 52.2% died within six months. Although there was a univariate association between nursing home resident one month survival and hospitals with a persistently high rate of feeding tube insertion (unadjusted odds ratio [OR] = 0.86; 95% confidence interval [CI]: 0.80, 0.92), this association was no longer statistically significant once individual, nursing home (from where the resident was hospitalized), and hospital characteristics were taken into account (Model 2, AOR = 0.93; 95% CI: 0.87, 1.01), suggesting that the unadjusted positive effect of hospitals having high feeding tube insertion rates with better survival was confounded by other factors such as the severity of individual health conditions (Table 3). In general, the odds of dying within one month did not differ from each other among the different hospital categories ($P = 0.25$).

These findings also held up in the sensitivity analysis comparing hospitals with "extremely" high vs. low rates of feeding tube insertion. Hospitals with "extremely" low use had 0% feeding tube insertions during both periods, and hospitals with "extremely" high use had at least a 14.9% feeding tube insertion rate in 2000–2003 and at least a 13.4% feeding tube insertion rate during 2004–2007. Relative to residents admitted to hospitals with virtually no feeding tube insertions ("extremely" low group, 80 hospitals), the odds of dying within one month of admission for residents admitted to hospitals with persistently high rates of insertions ("extremely" high group, 69 hospitals) was not statistically significant from those admitted to hospitals with persistently low rates of insertion, after adjusting for other covariates such as individual conditions (e.g., AOR = 0.97, 95% CI: 0.77, 1.22, results available on request).

As presented in Table 3, individuals admitted to hospitals with persistently high insertion rates did not experience improved six month survival when compared with those admitted to hospitals with persistently low rates in either the unadjusted Model 1 (unadjusted OR = 0.95; 95% CI: 0.90, 1.02) or Model 2 that adjusted for additional covariates (AOR = 1.02; 95% CI: 0.95, 1.09). Further, the odds of mortality associated with the variations of hospital tube insertions were not significantly different from each other among the nine hospital categories ($P = 0.55$).

The sensitivity analysis showed higher six month mortality in hospitals with persistently high levels of tube insertion ("extremely"

*Table 2*

**Distribution of Individual and Hospital Characteristics of the Nine Groups of Hospitals**[a]

| Subgroups of Hospitals | 1: Low-Low | 2: Low-Med | 3: Low-High | 4: Med-Low | 5: Med-Med | 6: Med-High | 7: High-Low | 8: High-Med | 9: High-High | *P*-value[b] |
|---|---|---|---|---|---|---|---|---|---|---|
| *Individual characteristics (total number of individuals = 56,824)* | | | | | | | | | | |
| No. of individuals | $n = 8359$ | $n = 6311$ | $n = 1537$ | $n = 6538$ | $n = 9065$ | $n = 5183$ | $n = 1906$ | $n = 5220$ | $n = 12{,}705$ | |
| Age at assessment (years) | 84.00 (7.31) | 84.20 (7.48) | 84.07 (7.26) | 84.16 (7.35) | 84.31 (7.42) | 83.85 (7.57) | 84.11 (7.59) | 84.07 (7.39) | 83.80 (7.80) | <0.01 |
| African American | 5.31% | 7.59% | 17.44% | 8.50% | 9.51% | 15.90% | 10.13% | 15.52% | 24.13% | <0.01 |
| Male | 32.71% | 32.10% | 31.10% | 30.90% | 31.21% | 31.82% | 31.43% | 31.93% | 33.02% | 0.06 |
| Severe functional impairment (ADL = 28) | 12.98% | 14.04% | 16.85% | 14.38% | 14.35% | 15.86% | 13.17% | 14.66% | 17.73% | <0.01 |
| CPS = 6 | 16.64% | 17.27% | 21.21% | 17.85% | 18.41% | 18.89% | 16.53% | 17.93% | 20.39% | <0.01 |
| Presence of legal guardian | 6.15% | 5.64% | 4.75% | 4.83% | 4.99% | 5.05% | 4.93% | 4.75% | 4.62% | <0.01 |
| Do not resuscitate | 63.58% | 58.04% | 46.91% | 57.45% | 52.04% | 44.82% | 54.46% | 43.28% | 37.23% | <0.01 |
| Feeding restriction | 7.30% | 7.48% | 5.34% | 7.42% | 5.44% | 4.19% | 4.30% | 4.77% | 4.29% | <0.01 |
| Congestive heart failure | 19.46% | 18.65% | 18.87% | 19.04% | 18.80% | 18.70% | 19.83% | 19.96% | 18.39% | 0.33 |
| Emphysema/COPD | 13.69% | 12.90% | 13.34% | 12.85% | 12.83% | 12.70% | 15.48% | 13.10% | 12.47% | 0.02 |
| Stroke | 21.78% | 23.12% | 23.36% | 22.48% | 24.16% | 24.19% | 23.14% | 23.72% | 24.73% | <0.01 |
| Cancer | 3.45% | 3.63% | 3.12% | 3.12% | 3.19% | 3.57% | 2.89% | 3.16% | 3.23% | 0.59 |
| Renal failure | 2.99% | 3.28% | 3.06% | 3.26% | 2.78% | 2.91% | 2.94% | 3.39% | 3.34% | 0.34 |
| Pneumonia/respiratory infection | 8.72% | 8.13% | 9.11% | 8.01% | 8.48% | 7.87% | 7.61% | 7.93% | 7.26% | <0.01 |
| CHESS scale (range 0–5) | 1.63 (1.20) | 1.63 (1.21) | 1.53 (1.20) | 1.59 (1.20) | 1.54 (1.20) | 1.49 (1.16) | 1.61 (1.20) | 1.49 (1.17) | 1.36 (1.15) | <0.01 |
| The interval between assessment in the MDS and the admission date (days) | 43.63 (39.30) | 43.25 (39.26) | 43.31 (39.41) | 43.14 (39.53) | 42.54 (39.21) | 42.55 (39.66) | 44.30 (40.43) | 42.19 (39.46) | 42.05 (39.14) | <0.01 |
| Admitted from nursing homes with chain membership | 58.62% | 56.39% | 65.78% | 54.76% | 52.80% | 53.52% | 60.91% | 54.52% | 46.60% | <0.01 |
| Admitted from for-profit nursing homes | 66.89% | 69.93% | 74.11% | 70.91% | 72.02% | 72.43% | 73.14% | 73.51% | 73.31% | <0.01 |
| Principal diagnosis of hospital admission | | | | | | | | | | |
| Pneumonia and other disease of lung | 20.04% | 19.25% | 19.13% | 18.95% | 18.51% | 18.31% | 17.94% | 17.57% | 17.28% | <0.01 |
| Septicemia | 9.53% | 10.44% | 13.53% | 11.01% | 11.88% | 12.21% | 11.96% | 13.05% | 13.31% | <0.01 |
| Other disorders of urethra and urinary tract | 8.12% | 8.46% | 9.24% | 8.66% | 8.80% | 8.45% | 7.87% | 8.28% | 8.34% | 0.71 |
| Disorder of fluid, electrolyte, and acid-base balance | 4.69% | 4.61% | 5.53% | 4.57% | 4.73% | 5.44% | 4.77% | 4.73% | 5.26% | 0.13 |
| Fracture of neck of femur | 6.34% | 5.83% | 4.55% | 6.13% | 5.33% | 5.31% | 5.19% | 4.06% | 3.31% | <0.01 |
| Heart failure | 4.10% | 3.31% | 3.71% | 3.49% | 3.77% | 3.36% | 3.15% | 3.75% | 3.21% | 0.04 |
| General symptoms | 2.46% | 2.38% | 1.89% | 2.68% | 2.99% | 2.80% | 2.78% | 2.55% | 3.14% | <0.01 |
| Acute renal failure | 4.04% | 4.02% | 3.97% | 4.14% | 4.27% | 3.90% | 4.25% | 4.62% | 4.25% | 0.77 |
| Acute myocardial infarction | 2.20% | 1.93% | 2.02% | 2.37% | 2.17% | 1.95% | 2.26% | 1.93% | 2.00% | 0.65 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| *Hospital characteristics (total number of hospitals = 1773)* | | | | | | | | | | |
| No. of hospitals | $n = 328$ | $n = 207$ | $n = 62$ | $n = 199$ | $n = 228$ | $n = 159$ | $n = 70$ | $n = 154$ | $n = 365$ | |
| Hospice days per decedent during end-of-life care (days) | 12.00 (3.76) | 12.61 (4.12) | 13.92 (4.64) | 12.30 (3.89) | 12.52 (4.11) | 13.32 (4.64) | 11.85 (3.06) | 12.93 (4.30) | 11.86 (4.33) | <0.01 |
| Profit status | 11.59% | 13.53% | 16.13% | 15.08% | 13.60% | 22.01% | 12.86% | 18.18% | 23.22% | <0.01 |
| Urban location | 66.06% | 73.91% | 70.97% | 81.41% | 84.65% | 80.25% | 78.57% | 86.67% | 88.42% | <0.01 |

COPD = chronic obstructive pulmonary disease; ADL = activities of daily living; CPS = cognitive performance score; CHESS = Changes in Health, End-Stage Disease and Symptoms and Signs; MDS = Minimum Data Set.

List of ICD-9 codes: Pneumonia and other disease of lung (ICD-9 code = 486, 507, or 518); Septicemia (ICD-9 = 038); Other disorders of urethra and urinary tract (ICD-9 = 599); Disorder of fluid, electrolyte, and acid-base balance (ICD-9 = 276); Fracture of neck of femur (ICD-9 = 820); Heart failure (ICD-9 = 428); General symptoms (ICD-9 = 780); Acute renal failure (ICD-9 = 584); Acute myocardial infarction (ICD-9 = 410).

[a]Data presented as % or mean (SD) as appropriate.

[b]*P*-value for the difference across the nine groups.

*Table 3*

**Association Between the Variation of Hospital Feeding Tube Insertion and Mortality Among Nursing Home Residents With Advanced Cognitive Impairment**

| Group 1: Low-Low as Reference | Group 2: Low-Med | Group 3: Low-High | Group 4: Med-Low | Group 5: Med-Med | Group 6: Med-High | Group 7: High-Low | Group 8: High-Med | Group 9: High-High |
|---|---|---|---|---|---|---|---|---|
| One month mortality (no. of individuals = 56,824, no. of facilities = 1773) OR (95% CI) | | | | | | | | |
| Model 1[a] | 1.020 (0.941, 1.104) | 0.957 (0.838, 1.092) | 0.999 (0.923, 1.082) | 0.999 (0.928, 1.076) | 0.937 (0.860, 1.021) | 1.059 (0.939, 1.194) | 1.000 (0.918, 1.089) | 0.861 (0.804, 0.922) |
| Model 2[a] | 1.016 (0.933, 1.105) | 0.958 (0.832, 1.104) | 0.996 (0.915, 1.084) | 0.999 (0.923, 1.081) | 0.972 (0.886, 1.066) | 1.084 (0.954, 1.233) | 1.008 (0.919, 1.106) | 0.933 (0.865, 1.007) |
| Six month mortality (no. of individuals = 52,802, no. of facilities = 1773) OR (95% CI) | | | | | | | | |
| Model 1[a] | 1.071 (0.994, 1.154) | 0.946 (0.838, 1.069) | 1.009 (0.937, 1.086) | 1.011 (0.945, 1.083) | 0.997 (0.921, 1.079) | 1.064 (0.950, 1.191) | 1.014 (0.937, 1.098) | 0.953 (0.895, 1.015) |
| Model 2[a] | 1.067 (0.987, 1.154) | 0.934 (0.820, 1.063) | 1.005 (0.929, 1.087) | 1.016 (0.945, 1.093) | 1.020 (0.937, 1.110) | 1.085 (0.963, 1.224) | 1.025 (0.941, 1.116) | 1.015 (0.947, 1.088) |

OR = odds ratio; CI = confidence interval.

[a]Model 1 adjusted for year trend; Model 2 additionally adjusted for sociodemographic characteristics (age, gender, race), advance directives (i.e., do not resuscitate, feeding restriction) and presence of legal guardian, activities of daily living (ADL) score, cognitive performance score (CPS), changes in Health, End-Stage Disease and Symptoms and Signs (CHESS) score, comorbidities (congestive heart failure, cancer, chronic obstructive pulmonary disease, stroke, cancer, renal failure, pneumonia or respiratory infection), time interval between the MDS assessment and the hospital admission and the characteristics of nursing homes from which residents were transferred (i.e., ownership status and chain membership), and additional hospital characteristics (i.e., ownership status, urban location, and hospice days per decedent during end-of-life care).

high group) when compared with those with virtually no tube insertions after adjusting for individual health conditions, and nursing home and additional hospital characteristics (e.g., AOR = 1.29, 95% CI: 1.04, 1.60, results available on request).

## Discussion

Ranking hospitals based on the patterns of feeding tube insertion, we examined the survival of nursing home residents with advanced cognitive impairment admitted to hospitals with different rates of feeding tube insertion. We did not find improved one month or six month survival in hospitals with relatively higher rates of feeding tube insertion when compared with those with lower rates. Thus, although the type of hospital was associated with the likelihood of getting a feeding tube being admitted to a high treatment intensity hospital (measured through feeding tube insertion rates) did not improve survival for patients with advanced cognitive impairment. Our findings were consistent with the results of prior research that showed tube feeding does not improve survival among demented populations.[15,32]

Our findings contribute to a growing literature that examines the relationship between the intensity of medical service utilization and patient outcomes. Although variations in health care utilization have been widely documented, studies are conflicting on whether higher treatment intensity is associated with better health outcomes.[17–19,21,33,34] Examining this relationship is challenging because of the lack of detailed individual clinical information that can be used to account for the potential bias resulting from individual differences (e.g., sicker patients are admitted to hospitals with higher treatment intensity patterns). Furthermore, it also has been argued that research should not only be focused on the decedents, but also should consider the potential survival benefits among a prospective cohort.[21,35,36] Our study is the first to focus on persons with advanced cognitive impairment. Further, our study addressed these concerns by using a prospective cohort of nursing home residents with advanced cognitive impairment and by using a data set (i.e., the MDS) that contains detailed information of individual health conditions. Our data sets allow for a more complete adjustment of individual disease severity and evidence of advance directives to examine whether a hospital culture of more aggressive feeding tube insertion was associated with improved survival. The prospective cohort allowed us to examine the potential survival benefits associated with the rate of feeding tube use in a hospital.

These results must be interpreted in light of research findings that show increased health care costs and potential complications associated with feeding tube insertions in elderly patients with dementia. Tube feeding is more expensive than hand-feeding from a Medicare or Medicaid perspective.[37,38] Feeding tubes lead to more health care utilization such as hospitalizations.[39] A prior study also indicates that 19% of the patients with a feeding tube insertion have their tubes either replaced or repositioned within a one year period, and the median time from initial tube placement to replacement or reposition is 144 days.[13] Furthermore, feeding tubes could lead to complications such as tube occlusion and leaking and infection.[32,40] Tube feeding is also likely to compromise quality of life by increasing discomfort for the patients.[32] For example, based on interviews with bereaved family members, 39% reported that the feeding tube disturbed the nursing home resident and 25.9% said that the nursing home resident was physically restrained.[41]

Several limitations need to be noted. First, we were only able to adjust for clinical measures that were included in the MDS. It is possible that there are unmeasured medical conditions that predict mortality. A second limitation was that we relied on ICD-9 and CPT codes in the claims to identify surgically placed feeding tubes. There could be inaccuracies in administrative data. However, because these data were used for reimbursement purposes, hospitals had financial incentives to file the claims accurately. Third, we were not able to distinguish the effect of care provided in the hospital from care received after discharge. Specifically, our findings suggest that nursing home residents with advanced cognitive impairment admitted to hospitals with an "extremely" high level of feeding tube use had higher six month mortality. However, we

were not able to attribute this effect to the care delivered in hospitals. These individuals may spend more time and receive their care out of hospitals, which may have greater impact on their survival.

In conclusion, we examined the relationship between hospital feeding tube insertion rates and survival among nursing home residents with advanced cognitive impairment, and we did not find better survival among those admitted to hospitals with persistently high rates of feeding tube insertion. The finding has policy implications for the current health care reform. One of the hotly debated issues concerns whether hospitals with a culture of more aggressive treatment have improved patient outcomes. Our findings provide evidence that higher rates of feeding tube insertion in the hospital (a marker for more aggressive treatment) may not necessarily translate into better outcomes. The observed variations in the rates of feeding tube insertion across hospitals and the lack of survival benefits among individuals with advanced cognitive impairment call for public efforts to ensure that insertion of feeding tubes is based on process of communication that elicits and respects the patient's choice. Future research about reasons for changes in hospital feeding tube insertion patterns is also warranted.

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