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Original Study

Facility-Level Factors and Outcomes After Skilled Nursing Facility Admission for Trauma and Surgical Patients

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A B S T R A C T

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Objective: Patients discharged to skilled nursing facilities (SNFs) have worse outcomes than those discharged to home, but whether this is due to differences in facility-level factors in addition to patient characteristics is not known. We aimed to determine whether SNF-level factors including nurse staffing and patient density are associated with outcomes after acute hospitalization for trauma or surgery.

Design, setting, participants, and measurements: Retrospective study of patients discharged to Medicare-certified SNFs after trauma or major surgery from 2007 to 2009. We measured the ratio of beds per nurse and the proportion of trauma and surgery patients at each facility (density). Outcomes were 1-year mortality, hospital readmission, and failure to discharge home at first discharge disposition.

Results: For 389,133 patients (mean age 78 years, 63% female) admitted to 3707 SNFs, mortality was 26%, hospital readmission 26%, and failure to discharge home 44%. After adjusting for patient-level factors, SNFs with fewer beds per nurse had lower odds of mortality [odds ratio (OR): trauma 0.84; (95% confidence interval: 0.77–0.91), surgery 0.80 (0.75–0.86)], readmission [OR: trauma 0.81 (0.74–0.88), surgery 0.71 (0.65–0.76)], and failure to discharge home [OR: trauma 0.82 [0.74–0.91], surgery 0.66 [0.60–0.72]]. SNFs with greater density of specialty patients (>4.3% surgery, >14.1% trauma) had lower odds of readmission [OR: trauma 0.59 (0.53–0.66), surgery 0.62 (0.58–0.67)] and failure to discharge home [OR: trauma 0.48 (0.43–0.55), surgery 0.45 (0.42–0.49)].

Conclusions: There are modifiable SNF-level factors that influence long-term outcomes and may be targets for intervention. Staffing standardization and SNF specialization may reduce variation of quality in post-acute care.

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Patients who experience trauma, like those who undergo major surgery, have unique care needs following acute hospitalization including wound care, management of orthopedic repairs, and rehabilitation for traumatic brain injury. Over the past 2 decades, length of stay (LOS) after surgery has decreased but at the cost of more admissions to postacute care (PAC) facilities as well as more frequent hospital readmissions.¹ After major trauma, 1 in 4 patients will be discharged to PAC facilities.² Although quality improvement for both trauma and surgery patients has focused on hospital-based care, the increased risk of mortality extends well beyond the acute hospitalization,^{3–5} including at skilled nursing facilities (SNFs) where potentially preventable adverse events (AEs) are frequently

reported and lead to hospital readmission.^{6,7} SNF-related AEs, including falls, medication errors, and infections, cause serious harm and nearly 25% of patients experience an unplanned hospital readmission.^{6,8–10} The Department of Health and Human Services estimated that in 2014, 22% of Medicare beneficiaries experienced AEs during their SNF stays, costing \$2.8 billion annually in subsequent hospital treatment for harm occurring while admitted to SNFs.¹¹

Prior studies have identified patient-level factors that are associated with poor outcomes after discharge to SNFs.^{12–16} The role of SNF-level factors in the occurrence of AEs and readmission, however, is poorly understood and may be an opportunity for targeted interventions for improving clinical outcomes. Hospitals have become increasingly specialized and trauma care regionalized, but there is little knowledge of the effect of specialization in the trauma or surgical population on AEs and its relation to hospital readmission in PAC.^{17–19} We hypothesized that SNFs with greater experience in caring for specialized patient populations (eg, SNFs with patient panels comprised of more trauma or surgical patients) demonstrate favorable outcomes and that nurse staffing ratios may also play a role in long-term outcomes in PAC.²⁰ In this study, we aimed to determine whether potentially modifiable facility-level factors were associated with outcomes measured by clinically significant events in a patient's transition through PAC: hospital readmission, failure to discharge to home, and death.

Methods

We performed a retrospective study of Medicare beneficiaries from a nonrandom sample of 5 states between 2007 and 2009. Washington, California, Texas, Florida, and New York were selected as geographically diverse states with large populations that represent a variety of patient demographics. Data was obtained from the Centers for Medicare and Medicaid Services (CMS) through the Research Data Assistance Center (University of Minnesota). CMS Master Beneficiary Summary File data was linked by social security number with hospitalization claims from the Medicare Provider Analysis and Review file, SNF-admission data using the Minimum Data Set (MDS), and with vital statistics from the National Death Index. This study was approved by the University of Washington Human Subjects Division institutional review board.

Cohort Selection

Adult patients hospitalized for trauma or major surgery based upon diagnosis (*International Classification of Diseases, Ninth Revision*) and procedure codes (current procedural terminology) (Appendix) who were subsequently admitted to Medicare-certified SNFs between January 1, 2007 and December 31, 2009 were selected for inclusion from 5 large states in around the country. Major surgeries were selected by procedure codes for operations that typically require inpatient admission. Patients were excluded if they had resided in a SNF in the prior 6 months, had a terminal diagnosis on SNF admission, or were receiving hospice care within the first week of SNF admission as documented in the MDS (an assessment performed at the time of a patient's admission to a SNF). Using claims from the Medicare Provider Analysis and Review file, we collected patient demographics (age and sex), Charlson comorbidity index (CCI, Deyo definition),²¹ hospital LOS, and intensive care unit (ICU) LOS as applicable. The following patient factors were obtained from the MDS: activities of daily living (ADL) scores, assessed cognitive level, the need for parenteral nutrition or tube feeds, and the presence of pressure ulcers.

Exposures

Facility-level data, including number of beds and number of employed nurses [registered nurses (RNs) with higher levels of training and licensed practical nurses (LPNs) with lower levels of training] for each SNF was obtained from Medicare's provider of services file during the first quarter of the study. Cross-sectional sampling of the number of nurses at each facility provided an estimate of employment patterns for the entire study period. We derived the following facility-level factors that may be associated with patient outcomes. First, bed:nurse ratio was defined as the number of facility beds per full time equivalent nurse (either RN or LPN) employed at each SNF. Second, we derived staffing ratios by nurse type (ie, bed:RN and bed:LPN). Third, we calculated the ratio of LPNs per RN. Lastly, as a measure of a SNF's degree of experience with specialty patients, density was defined as the proportion of a facility's total patient census made up by patients with either a history of trauma or major surgery.

Outcomes

We measured each patient's first discharge disposition after SNF admission during 3 years of follow-up through 2012. Patient deaths were identified with the National Death Index data through 2010. Outcomes were hospital readmission, failure to discharge home on the first disposition (including discharge to rehabilitation facility, long-term acute care, or hospice), and 1-year mortality.

Missing Data for Clinical Factors

Missing data was present from 0.3% to 7.3% of clinical variables. We performed 10 iterations of multivariate imputation using chained equations to generate plausible values for records with missing data.^{22,23} Common factors used in predicting the missing values included age, sex, CCI, ICU LOS, presence of pressure ulcers, and category of surgical procedures. Sensitivity analysis showed no differences between cases with complete and imputed data.

Analysis

We anticipated that outcomes from SNFs with very few trauma or surgical admissions during the 3-year study period would bias assessment of outcomes therefore we excluded SNFs in the lowest quartile for volume of trauma or surgical admissions [853 facilities with <9 trauma or surgical admissions (2983 patients, <1% of the initial cohort)]. There were 2 primary analyses in this study: First, in an analysis of variability at SNFs we used multivariate logistic regression models (accounting for clustering effects at the SNF level) to calculate risk-adjusted event rates for mortality, hospital readmission, and failure to discharge home from each SNF in the study. "Expected" event rates are reported after risk adjustment for patient level factors associated with adverse outcomes (age, sex, CCI, ADL score, history of ICU stay, parenteral nutrition use, presence of pressure ulcers, cognitive status, emergency admission status (surgical patients) and injury severity score for trauma patients). We report observed-to-expected event ratios and corresponding 95% confidence intervals (CIs) for each outcome by facility. Second, in adjusted analysis of SNFs facility-level factors and patient outcomes, we divided SNFs into quintiles by bed:nurse ratio, LPN:RN ratio, and trauma/surgical density. Logistic regression models were used to calculate the adjusted odds ratio (OR) and 95% CI of death, hospital readmission and failure to discharge home after controlling for all relevant clinical and demographic factors described above. Reference groups were defined as the lowest quintile. All statistical analyses were performed using Stata software v 12.0 (StataCorp, College Station, TX).

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