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Original Study

Functional Status Outperforms Comorbidities as a Predictor of 30-Day Acute Care Readmissions in the Inpatient Rehabilitation Population



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A B S T R A C T

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Objectives: Functional status is associated with patient outcomes, but is rarely included in hospital readmission risk models. The objective of this study was to determine whether functional status is a better predictor of 30-day acute care readmission than traditionally investigated variables including demographics and comorbidities.

Design: Retrospective database analysis between 2002 and 2011.

Setting: 1158 US inpatient rehabilitation facilities.

Participants: 4,199,002 inpatient rehabilitation facility admissions comprising patients from 16 impairment groups within the Uniform Data System for Medical Rehabilitation database.

Measurements: Logistic regression models predicting 30-day readmission were developed based on age, gender, comorbidities (Elixhauser comorbidity index, Deyo-Charlson comorbidity index, and Medicare comorbidity tier system), and functional status [Functional Independence Measure (FIM)]. We hypothesized that (1) function-based models would outperform demographic- and comorbidity-based models and (2) the addition of demographic and comorbidity data would not significantly enhance function-based models. For each impairment group, Function Only Models were compared against Demographic-Comorbidity Models and Function Plus Models (Function-Demographic-Comorbidity Models). The primary outcome was 30-day readmission, and the primary measure of model performance was the c-statistic.

Results: All-cause 30-day readmission rate from inpatient rehabilitation facilities to acute care hospitals was 9.87%. C-statistics for the Function Only Models were 0.64 to 0.70. For all 16 impairment groups, the Function Only Model demonstrated better c-statistics than the Demographic-Comorbidity Models (c-statistic difference: 0.03–0.12). The best-performing Function Plus Models exhibited negligible improvements in model performance compared to Function Only Models, with c-statistic improvements of only 0.01 to 0.05.

The authors declare no conflicts of interest.

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Conclusion: Readmissions are currently used as a marker of hospital performance, with recent financial penalties to hospitals for excessive readmissions. Function-based readmission models outperform models based only on demographics and comorbidities. Readmission risk models would benefit from the inclusion of functional status as a primary predictor.

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Hospital readmissions are increasingly important markers of health care quality. In 2013, there were more than 3.9 million readmissions within 30 days of hospital discharge, translating into more than \$52 billion in hospital costs.¹ The Centers for Medicare & Medicaid Services (CMS) provides public reporting statistics for readmissions and extracts financial penalties from hospitals with higher than expected readmission rates²; more than 2200 hospitals were fined a total of \$280 million in reduced Medicare payments in fiscal year 2013.³ However, the relationship between readmission rates and quality of care is uncertain.⁴ There is a body of literature assessing risk prediction models for readmissions,⁵ but reductions in readmission rates have been modest and it is unclear how to further reduce readmissions.⁶

Postacute care is a major source of health care costs, accounting for 21% of Medicare expenditures versus 29% spent on acute care for Medicare beneficiaries ages 65 and older in 2011.⁷ There is a trend toward increasing utilization of postacute care services, translating into 1.67 million more discharges to postacute care facilities, a 49% relative increase between 1996 and 2010.⁸ The combined costs of postacute care and readmissions in the 30 days postdischarge now approximate the costs of index hospital admissions,⁹ yet the vast majority of attention toward readmissions has been focused on the acute care hospitalization. More than 40% of hospitalized Medicare patients are discharged to postacute care.¹⁰ Annually, more than 370,000 patients are admitted to inpatient rehabilitation facilities (IRFs), amounting to \$7 billion in Medicare costs.¹¹ According to recent Medicare claims data, the rate of 30-day readmission from an IRF was 12.4%, representing an opportunity for improvement.¹² To capture unplanned 30-day readmissions from IRFs, CMS developed the All-Cause Unplanned Readmission Measure for 30 Days Post Discharge from Inpatient Rehabilitation Facilities; public reporting of these statistics begins in October 2016.¹² Better management of postacute care is challenging as we move into an era of accountable care.¹³

Unfortunately, prior readmission models have yielded poor discriminative ability (*c*-statistics: 0.55–0.65).^{5,6} Studies have been limited by small sample sizes, restricted samples (eg, geriatric patients, patients with cardiac disorders, pneumonia, renal disease, etc), or non-US populations within different health care systems that might not apply to US patterns of readmission.⁵ It remains difficult to develop a coherent conceptual model to accurately predict readmissions. Most models have focused on comorbidities and demographics as the central readmission risk factors. However, few studies have considered the contribution of functional status—a patient's level of mobility, cognitive status, and ability to perform activities of daily living (ADL)—to readmission risk.⁵ There is growing evidence that functional status is an important predictor of patient outcomes and mortality,^{14–18} and interventions that improve functional status improve patient outcomes.¹⁹

Research on functional status is largely obtained from the IRF setting. The inpatient rehabilitation population is well situated for research on function and readmissions because (1) IRFs routinely document patient functional status using a validated instrument—the Functional Independence Measure (FIM)²⁰; (2) a majority (70%) of US IRFs participate in a national data set that contains standardized functional data—the Uniform Data System for Medical Rehabilitation (UDSMR); (3) inpatient rehabilitation patients often have complex

care transitions with high rates of readmission^{11,21}; and (4) functional status at the time of IRF admission is a proxy for patient functional status at the time of acute care discharge.¹⁶

The aim of this study was to compare functional status with comorbidities and demographics as predictors of acute care readmissions in a large US sample of more than 4 million inpatient rehabilitation patients from more than 1100 facilities. We previously performed similar model comparisons of functional status with comorbidities and demographics within the medically complex inpatient rehabilitation population, and demonstrated that function-based readmission models outperform comorbidity and demographic-based models; however, medically complex patients comprise only 3% of the IRF population.²² An objective of this study is to determine whether these preliminary results are representative of the entire IRF population. We hypothesized that readmission prediction models based on functional status would outperform models based on comorbidities and demographics, and the addition of demographic and comorbidity variables to function-based models would not significantly enhance model predictive performance.

Methods

Study Design, Setting, and Population

Data were obtained from the UDSMR, a data repository of IRF patients in the United States. The data set includes IRF-Patient Assessment Instrument data, which are composed of demographic, functional, medical, and facility data for approximately 70% of US IRFs. Individual IRF admissions for adult patients ≥ 18 years of age occurring between 2002 and 2011 were included in the study. There are 17 impairment groups, defined as the primary reason for rehabilitation admission, representing the entire inpatient rehabilitation population.²³ The developmental disability impairment group (due to <200 subjects) and those discharged against medical advice were excluded. Also, patients at an IRF where more than 5% of patients were admitted on the same day as the acute care admission were excluded as these IRFs have been identified as atypical in prior studies.²⁴ We chose not to exclude from analysis IRF admissions whereupon patients died (0.19%) because they may represent sicker patients with a higher potential for acute care readmission, and their exclusion may contribute to bias. This study was considered exempt by the institutional review board because the data set was deidentified.

Primary Outcome and Study Variables

The primary outcome variable was acute care readmission (discharge from an IRF to acute care facility with subsequent admission) within 30 days. Predictor variables included age, gender, functional status at admission, and medical comorbidities. Functional status was measured using the validated FIM instrument, which assesses function using 18 items.²⁰ Each item is rated with a 7-level ordinal scale from completely dependent (1) to independent (7), with a total score range of 18 to 126. The FIM instrument is composed of 2 domains: motor (13 items) and cognitive (5 items) (Table 1). FIM instrument scores were obtained within 72 hours of IRF admission and represent a metric of function close to the time of acute care

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