

ABSTRACT

Objectives. Length of stay (LOS) and hospital readmission for persons receiving medical rehabilitation were examined.

Methods. A total of 96 473 patient records (1994–1998) were analyzed. Mean age of patients was 68.97 years; 61% were female and 83% were non-Hispanic White.

Results. A decrease in LOS of 6.07 days (SD=3.23) and increase in hospital readmission were found across all impairment groups ($P<.001$). Readmission increases ranged from 6.7% for amputations to 1.4% for orthopedic conditions. LOS was longer (2.1 days) for readmitted patients ($P<.01$). Age was not a significant predictor of rehospitalization.

Conclusions. Understanding variables associated with rehospitalization is important as prospective payment systems are introduced for postacute care. (*Am J Public Health.* 2000;90:1920–1923)

Length of Stay and Hospital Readmission for Persons With Disabilities

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Hospital readmission costs have been identified as a major component of health care spending in the United States and account for approximately 24% of Medicare expenditures.^{1–4} The occurrence of unplanned readmission among high-cost patients, such as the elderly and those with chronic disease, is a significant concern as prospective payment systems are implemented for medical rehabilitation and postacute care.^{5–11}

We examined the relation between length of stay (LOS) and hospital readmission in a large sample of patients who received inpatient medical rehabilitation from 1994 through 1998. Our goal was to provide basic descriptive information regarding trends between LOS and readmission across different rehabilitation impairment groups.

Methods

Data from 96 473 patients who received medical rehabilitation from 1994 through 1998 were collected from 167 hospitals in 40 states

subscribing to the Uniform Data System for Medical Rehabilitation (UDSMR). The UDSMR is the largest national registry of standardized information on medical rehabilitation inpatients in the United States.¹² Information in the database includes scores on a standardized measure of basic daily living skills, the Functional Independence Measure, demographic variables, facility characteristics, diagnoses (*International Classification of Diseases, Ninth Revision [ICD-9]*, codes), and LOS.¹³ Detailed

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information regarding reliability and validity of the data collection system has been reported by several independent researchers.¹⁴⁻¹⁸

Validity of the Data Set

The UDSMR database was extensively reviewed by the Health Care Financing Administration (HCFA) in its examination of Function Related Groups.^{19,20} Function Related Groups were developed as the analog to Diagnosis Related Groups (DRGs) for inpatient medical rehabilitation.²¹ The Function Related Group classification system uses admission scores from the Functional Independence Measure and other demographic and clinical data to construct a severity-adjusted case-mix score that categorizes patients on the basis of (projected) LOS.^{21,22} In examining the Function Related Group system, the HCFA compared the UDSMR data set with the Medical Provider Annual Review (MEDPAR) file and the Health Care Provider Cost Report Information System¹⁹ and concluded that "UDSMR hospitals account for a substantial portion of the Medicare rehabilitation cases in almost all states"^{20(p24)} and that patient demographics, hospital characteristics, and resources used by disabled Medicare beneficiaries "are represented well by the UDSMR."^{20(p28)}

Complete admission, discharge, and follow-up information was available for 114440 patients receiving inpatient rehabilitation for the 5-year study period. We excluded patients with missing or out-of-range data values ($n=4577$), with nonspecific impairment codes ($n=641$), younger than 16 years ($n=602$), who were readmitted or transferred from another rehabilitation facility ($n=7011$), or who were admitted for evaluation only ($n=1602$). We used clinical criteria developed in research on Function Related Groups^{21,22} to exclude patients whose rehabilitation was atypical ($n=3534$) (e.g., a rehabilitation LOS of fewer than 2 days or more than 365 days). The remaining 96473 patients represented 84.3% of the usable patient records from the original sample.

Measures of LOS and Readmission

LOS was calculated as the total number of medical rehabilitation days. Information on rehospitalization was obtained between 80 and 180 days after discharge by telephone interviews conducted by trained registered nurses with clinical experience in rehabilitation. A protocol was followed to gather information on current living situation and whether the former patient experienced a hospital readmission. Any new medical diagnosis since discharge was recorded. The statistical consistency of solicit-

TABLE 1—Demographic Characteristics and Descriptive Statistics of Patients Who Received Medical Rehabilitation From 1994 Through 1998

	All Patients	Patients Without Readmission	Patients With Readmission
n	96 473	80 833 (83.8%)	15 640 (16.2%)
Sex			
Male	37 624 (39%)	32 333 (40%)	5 943 (38%)
Female	58 849 (61%)	48 500 (60%)	9 697 (62%)
Age, y	68.97 (SD = 15.48)	69.00 (SD = 15.57)	68.70 (SD = 16.98)
Race/ethnicity ^a			
White	79 812	66 450	13 362
Black	8 349	6 929	1 420
Hispanic	3 774	3 132	624
Other	3 210	2 695	515
LOS	19.92 (SD = 14.58)	19.58 (SD = 14.59)	21.68 (SD = 15.89)

Note. LOS=length of stay.

^aData on race/ethnicity not available for 1328 patients.

ing this information by telephone interview has been established in previous investigations.^{18,23}

Results

Descriptive and demographic information for all patients appears in Table 1. The type of impairment was examined through a classification system developed by Stineman and colleagues in establishing the Function Related Groups^{21,22} and included 8 rehabilitation impairment categories. The number of patients in each category ranged from 31 479 for orthopedic conditions to 3499 for cardiac rehabilitation. Detailed information on the criteria and ICD-9 codes used to create the rehabilitation impairment categories can be found elsewhere.^{21,22}

LOS decreased by 6.07 days ($F=61.77$, $P<.001$) across all rehabilitation impairment categories, from a mean of 22.97 days ($SD=15.52$) in 1994 to 16.90 days ($SD=15.70$) in 1998. Mean LOS was longer (21.68 days, $SD=15.89$) for patients who were rehospitalized than for those who were not (19.58 days, $SD=14.59$) ($t=16.15$, $P<.001$). The percentage of patients rehospitalized increased during the 5-year period, from a mean of 15.0% in 1994 to 17.8% in 1997 (Figure 1). All 8 rehabilitation impairment categories showed some increase in incidence of hospital readmission.

Using longitudinal analytic methods²⁴ and the rehabilitation impairment category, we calculated a summary measure of the relative rates of readmission for groups of patients. We used hospital readmission percentages for 1994 as the baseline and compared these with mean readmission percentages for

1997-1998. Statistical adjustments were made for age, race, sex, and LOS. The analysis involved a quasi-likelihood method applicable to discrete and continuous data.²⁴ The estimates of relative readmission rates for the 8 rehabilitation impairment categories were as follows: stroke, 1.57 (95% confidence interval [CI]=1.34, 1.80); brain injury, 1.48 (95% CI=1.24, 1.89); spinal cord injury, 1.51 (95% CI=1.34, 1.80); other neurologic conditions, 3.12 (95% CI=2.45, 4.64); amputation, 4.23 (95% CI=3.34, 5.80); arthritis, 2.16 (95% CI=1.74, 2.69); orthopedic, 1.47 (95% CI=1.24, 1.76); cardiac, 1.62 (95% CI=1.48, 1.81).

Discussion

LOS for inpatient medical rehabilitation decreased significantly and the percentage of patients rehospitalized increased for all rehabilitation impairment categories examined during the 5-year period. The relative rate for rehospitalization was highest for patients in the rehabilitation impairment categories of amputation and neurologic disorders.

The cost savings associated with shortened LOS are lost when patients are rehospitalized. The decrease in mean LOS of 6.07 days from 1994 to 1998 represents a savings of \$3521 per patient (1996 dollars).²⁵ In contrast, the estimated cost of 1 readmission in 1996 was \$8798.^{25,26} We are not arguing that there is a causal connection between decreasing LOS and increasing hospital readmission rates. Many potential moderator variables exist that may influence hospital readmission.¹⁰ The task of modeling the relations among these variables is complex,²⁷ but it must be addressed if hospital readmission rates are to be used as

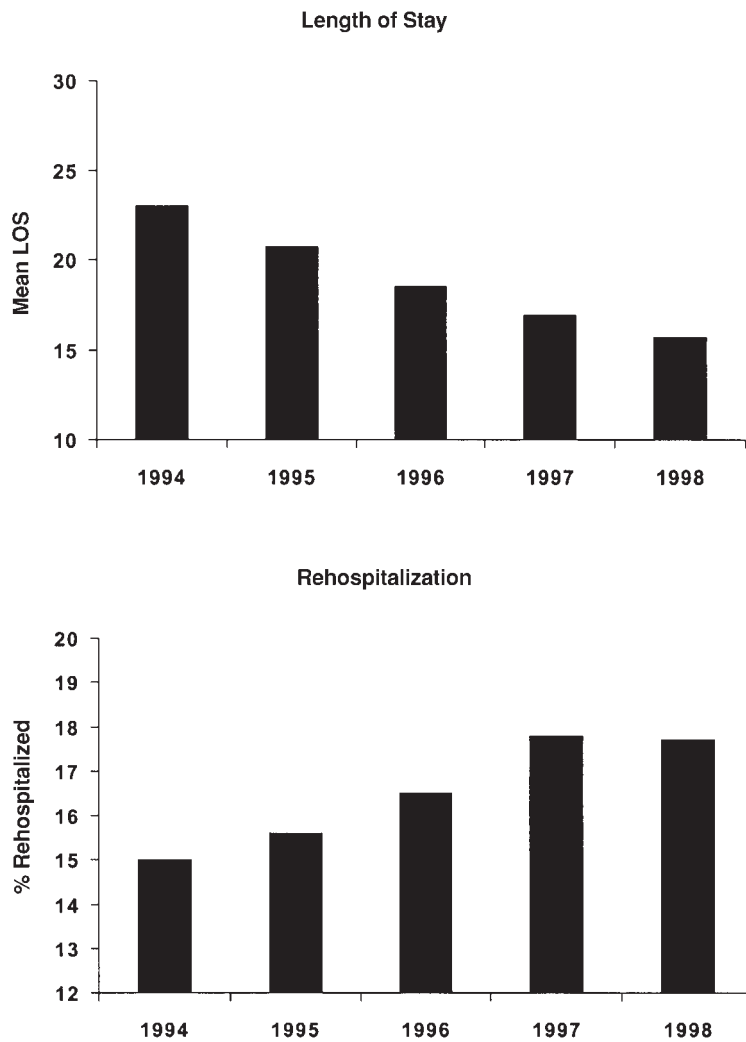


FIGURE 1—Comparison of mean length of stay (LOS) and percentage of hospital readmissions over a 5-year period (1994–1998), collapsed for 8 major rehabilitation impairment categories.

outcome indicators^{2,3} in prospective payment systems for postacute care. □

Contributors

K. J. Ottenbacher planned the study, analyzed the data, and wrote the first draft of the paper. P. M. Smith and S. B. Illig collected the follow-up data, participated in the analysis, and contributed to the Methods section. R. C. Fiedler analyzed the original data, merged data sets, assisted in the statistical analysis, and contributed to the Results section. C. V. Granger assisted in planning the study and reviewing and writing all sections of the paper.

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