Acute Inpatient Rehabilitation Length of Stay and Outcomes for Patients Enrolled in the Traumatic Brain Injury Model System – 2010-2017

Michael Chiou, MD & Kirk Lercher, MD

Department of Rehabilitation and Human Performance, Icahn School of Medicine at Mount Sinai, New York, NY

INTRODUCTION

Traditionally, discharge from an inpatient rehabilitation facility to home occurred at the point when a patient's functional and education gains begin to plateau. Brain injury clinicians face increasing pressures to reduce length of stay, and many providers continue to feel that it has become too short and may place patients at increased risk for post-discharge complications. It is unknown how short inpatient rehabilitation facility length of stay (IRF-LOS) can become before patients living with TBI suffer negative outcomes, which ultimately results in higher healthcare costs.

This study is designed to explore trends in decreasing IRF-LOS as they pertain to patient demographics, injury-related factors, functional status, and outcomes for 7,079 individuals enrolled in the TBI Model System between 2010-17. The objectives of the study are to explore trends in IRF-LOS; to describe predictors of IRF-LOS using patient demographic, injury-related, and functional data; and to investigate adverse outcomes as they relate to discharge from inpatient rehabilitation.

METHODS

This study uses existing data from the National TBI Model System Database. Two sources of data were collected from the patient sample: (1) Form I includes data collected at time of admission and discharge from an inpatient rehabilitation facility and (2) Form II is collected at various anniversaries throughout the lifespan of each patient.

All analyses were conducted using SPSS version 25. Frequencies were computed for clinical and patient demographics on admission and discharge from an inpatient rehabilitation facility. A stepwise linear regression model was examined using the natural log of IRF-LOS as the dependent variable because length of stay was skewed. Logistic regression analysis was conducted to examine rehospitalization at first year anniversary.

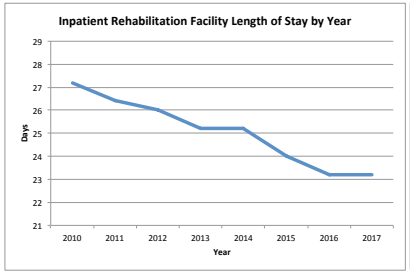
Stepwise Regression of IPR-LOS on Patient Characteristics in Order of Entry.

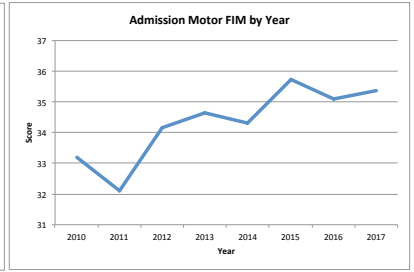
Variables	Unstandardized Coefficient	Standard Error	Standardized Coefficient	t	p
Admission Motor FIM	-0.007	0.0002	-0.384	-30.989	<.001
Admission Cognitive FIM	-0.002	0.001	-0.048	-3.864	<.001
Admission DRS	0.011	0.001	0.187	13.671	<.001
Initial GCS ≤ 8	0.020	0.006	0.032	3.191	0.001
Year	-0.003	0.001	-0.021	-2.261	0.024
Length of Acute Hospital Stay	0.003	0.0002	0.166	16.491	<.001
Discharge to Home	-0.073	0.007	-0.094	-9.894	<.001
≤ High School Education	-0.036	0.006	-0.058	-6.262	<.001
African American	-0.023	0.008	-0.027	-2.899	0.004
Intercept	1.446	0.020		71.783	<.001

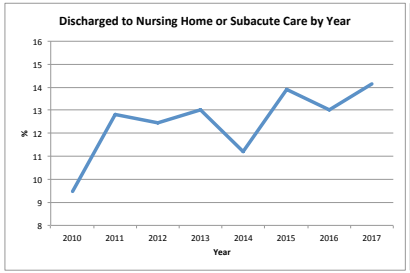
Total adjusted R^2 = .44; F = 592.7; df = 9; p < .001

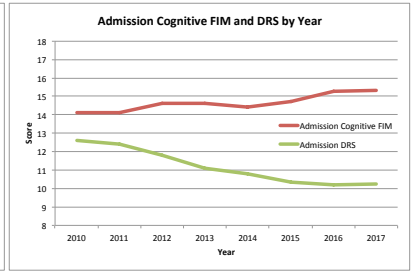
Abbreviations: Inpatient Rehabilitation Facility Length of Stay (IPR-LOS), Functional Independence Measure (FIM), Disability Rating Scale (DRS), Glasgow Coma Score (GCS)

RESULTS









Logistic Regression of Year 1 Outcome Variables on Selected Predictor Variables.

Variables	Unstandardized Coefficient	Standard Error	X^2	p	Odds Ratio	95% CI
Rehospitalization						
Age	0.007	0.002	17.17	<.001	1.007	1.004-1.010
Discharge Motor FIM	-0.012	0.002	28.44	<.001	0.988	0.983-0.992
Discharge Cognitive FIM	-0.014	0.006	6.031	0.014	0.986	0.975-0.997
Discharge to Home	-0.414	0.085	23.97	<.001	0.661	0.560-0.780
IPR-LOS	0.005	0.001	13.95	<.001	1.005	1.002-1.008
Intercept	0.038	0.189	0.040	0.842	1.039	

X^2 = 225.9; df = 5; p < .001

Abbreviations: Inpatient Rehabilitation Facility Length of Stay (IPR-LOS), Functional Independence Measure (FIM)

REFERENCES

1. Chan L, Koppell TD, Deyo RA, et al. The effect of Medicare's payment system for rehabilitation hospitals on length of stay, charges, and total payments. N Engl J Med. 1997;337(14):978-985.
2. Chan L, Cost M. Medicare's payment system: Its effect on discharges to skilled nursing facilities from rehabilitation hospitals. Arch Phys Med Rehabil. 2000;81(6):715-719.
3. Hoffman JM, Dorsolo Brown E, Chan L, Diviren S, Tamkin N, Bell KR. Change in inpatient rehabilitation admissions for individuals with traumatic brain injury after implementation of the Medicare inpatient rehabilitation facility prospective payment system. Arch Phys Med Rehabil. 2012;93(8):1305-1312.
4. Pretz CR, Graham JE, Middleton A, Karmarkar AM, Ottenbacher KJ. Longitudinal Investigation of Rehospitalization Patterns in Spinal Cord Injury and Traumatic Brain Injury Among Medicare Beneficiaries. *Arch Phys Med Rehabil*. 2017;98(5):997-1003.
5. Malec JF, Ketchum JM, Hammond FM, et al. Longitudinal Effects of Medical Comorbidities on Functional Outcome and Life Satisfaction After Traumatic Brain Injury: An Individual Growth Curve Analysis of NIDILRR Traumatic Brain Injury Model System Data. *J Head Trauma Rehabil*. 2019;34(5):E24-E35.

DISCUSSION

The strongest predictors of IRF-LOS are functional status at admission and severity of injury. Year is also a powerful predictor of IRF-LOS. Obviously, the length of stay has been decreasing year after year. The impact of third-party payers, including the Centers for Medicare & Medicaid Services (CMS), should not be understated [1,2,3]. These entities aim to decrease overall healthcare costs. At inpatient rehabilitation facilities, this is achieved by decreasing allowable IRF-LOS, a constraint which may negatively impact patient outcomes. Given the ever-tightening constraints on IRF-LOS, clinicians continue to make the tough decision between discharging a patient to home with a higher level of impairment needing more advanced caregiver training and at the expense of increased caregiver burden, or to another facility because families are unable to provide adequate care.

The rate of rehospitalization varied between 2010 and 2017. Rehospitalization was predicted most strongly by age, followed by lower motor and cognitive FIM scores at discharge. Longer IRF-LOS was correlated with rehospitalization within one year. This may be related to insufficient time in rehabilitation, medical complications occurring after discharge, or overall medical complexity [4,5].

The rate of discharge to either a nursing home or subacute rehabilitation increased significantly between 2010 and 2017. Such facilities may serve as a stepping-stone in further recovery after inpatient rehabilitation. However, we must ask the question of why individuals were discharged to such facilities at all. It has been reported that social supports (family and marital status) and home environment play a key role in discharge to home. Further investigation may help to elucidate whether there is an issue with social or environmental factors, or whether scarcity of financial resources prohibit adequate inpatient rehabilitation care.

CONCLUSION

This study suggests that shorter IRF-LOS was facilitated by higher levels of functional ability on admission and lower post-injury disability. While at first it may seem logical that higher functioning and less severely injured patients are an optimal choice for an inpatient rehabilitation facility, consider that such facilities exist to provide for the most challenging rehabilitation patients, those that would not succeed at lesser-equipped facilities. Continued decreases in length of stay diminish the ability for brain injury medicine clinicians to admit and care for a growing population of complex rehabilitation patients.