

Inpatient Rehabilitation after Spinal Cord Injury Is Associated with Reduced 90-Day Acute Care Hospital Costs Compared to Skilled Nursing Facility Care

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Background

- Spinal cord injury (SCI) affects 300,000 in U.S.A.
- Disability is due to sensory and motor deficits
- Post-acute care at an inpatient rehabilitation facility (**IRF**) is expensive and limited by IRF bed scarcity
- Many patients are thus sent to skilled nursing facilities (**SNF**)
- Hypothesis IRF care leads to decreased healthcare system costs and utilization compared to SNF care after hospital discharge

Aims

Quantify impact of IRF vs. SNF care on:

- 1) healthcare system costs
- readmission rates 2)
- 3) rates of emergency department encounters

Methods

- Difference-in-differences (**DID**) study design
- Treatment: IRF vs. SNF
- 90-day pre-injury baseline
- 90-day post-discharge follow-up
- Callaway-Sant'Anna (**CS-DID**) replication of DID study design with covariates
- Costs calculated from charges using hospitalspecific cost-to-charge ratios

Inclusion Criteria

- <u>Population</u>: newly diagnosed adult SCI patients
- Data Source: multi-institutional cohort (HCUP SID, SEDD)
- States: AR, FL, MA, ME, NY, WI
- Years: 2016-2021
- <u>ICD-10 codes</u>, any in at least one inpatient encounter:
- S14XXXA cervical SCI, initial encounter
- S24XXXA thoracic SCI, initial encounter
- S34XXXA lumbosacral SCI, initial encounter
- <u>Timing</u>: injury after Q1, discharge before Q4



Characteristic	SNF N = 1,710	IRF N = 2,520
Age	69 (17)	54 (20)
Race		
White	1,218 (71%)	1,628 (64%)
Black	271 (16%)	493 (19%)
Hispanic	114 (7%)	202 (8%)
Other	118 (6%)	220 (9%)
Sex		
Female	699 (41%)	665 (26%)
Male	1,022 (59%)	1,878 (74%)
Primary Payor		
Private	292 (17%)	1,002 (39%)
Medicare	1,142 (66%)	860 (34%)
Medicaid	207 (12%)	413 (16%)
Other	80 (4.6%)	268 (11%)
Length of Stay	16 (24%)	14 (17%)
Geographic Adjustment Factor	1.02 (0.13)	1.01 (0.13)
ZIP Income Quartile		
1	490 (29%)	718 (28%)
2	446 (26%)	693 (28%)
3	422 (25%)	556 (22%)
4	352 (21%)	553 (22%)
AIS General	0.10 (0.50)	0.15 (0.64)
AIS Head Neck	2.42 (1.88)	2.67 (1.84)
AIS Face	0.20 (0.63)	0.28 (0.76)
AIS Extremities	0.39 (0.86)	0.44 (0.91)
AIS Chest	1.11 (1.63)	1.31 (1.77)
AIS Abdomen	0.51 (1.01)	0.58 (1.14)
RISS	16 (12)	19 (13)
Presence of TBI	269 (16%)	567 (22%)
Injury Level		
Cervical	1,170 (69%)	1,722 (68%)
Thoracic	310 (18%)	486 (19%)
Lumbosacral	230 (13%)	312 (12%)
Elixhauser Score	10 (13)	8 (11)

Table 1. Characteristics of patients discharged to SNF and IRF. Patients discharged to SNF tended to be older, female, and covered by public insurance. Categorical covariates are shown with percentages of the respective cohort in parentheses, whereas numerical covariates are shown with standard deviations in parentheses. AIS = Abbreviated Injury Score, RISS = Revised Injury Severity Score, TBI = Traumatic Brain Injury



Figure 3. Event-study plot of mean cost-savings associated with IRF care over SNF care. Outcome is dollars saved from a payor perspective. Gray shading represents 95% confidence interval around means.

	Method	Injury Level (n)					_	
ings		All (4266)	Cervical (2920)	Thoracic (801)	Lumbosacral (545)		R	
ealth	DID	-\$3253*	-\$4015*	-\$904	-\$2,410	j		
ances	CS-DID	-\$2738*	-\$3808*	-\$1,570	-\$649		li	
licly	DID	-\$3451*	-\$3866*	-\$1,562	-\$3,810			
ured	CS-DID	-\$4030*	-\$4338*	-\$3,393	-\$5,378			

Table 2. DID and CS-DID estimates of 90-day cost-savings associated with IRF over SNF care. All-comers in adjusted (CS-DID) analysis can expect an average \$2738 reduction in 90-day acute care costs. Examining different subgroups based on insurance status and anatomic injury level yields modified estimates. Asterisk (*) indicates significance (p<0.05).

Readmission Reduction	Method	Injury Level (n)				
		All (4266)	Cervical (2920)	Thoracic (801)	Lumbosacı (545)	
All Health	DID	-9.16% *	-9.84% *	-5.30%	-10.64%	
Insurances	CS-DID	-7.76% *	-9.25% *	-10.0%	-3.07%	
Publicly	DID	-9.26% *	-8.60% *	-7.21%	-14.17%	
Insured	CS-DID	-10.33% *	-9.42% *	-9.56%	-25.07%	

Table 3. DID and CS-DID estimates of 90-day reduction in readmission rates associated with IRF over SNF care. All-comers in adjusted (CS-DID) analysis can expect an average 7.76 percentage-point reduction in 90-day acute care costs. Examining different subgroups based on insurance status and anatomic injury level yields modified estimates. Asterisk (*) indicates significance (p<0.05).

Figure 4. Sunburst plot depicting 90-day healthcare utilization trajectory of SCI patients following SNF versus IRF disposition. Read from inner to outer, successive layers indicate the sequence of care facilities and discharge dispositions utilized by SCI patients, including rehospitalizations and emergency department encounters, within 90-days after discharge.

Conclusions

- **IRF significantly reduces** 90-day:
- acute healthcare costs (-\$2783)
- readmission rates (-7.76%)

versus SNF. These are likely related!

Benefits of IRF are magnified with:

- public insurance (-\$4030, -10.3%)
- cervical SCI (-\$3808, -9.25%)
- Savings likely do not cover cost of IRF care but may become costeffective when considering:
- care quality (payor metric)
- quality-of-life (patient metric)
- due to reduced readmissions!

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- **Readmissions were nearly** double after SNF vs. IRF care • 30.8% vs. 15.8% of patients
- Only 2.8% of patients first triaged to SNF were ever retriaged to IRF
- Patient-level or insurance factors affect re-triage in subsequent encounters

State	SNF (%)	IRF (%)	Odds Ratio
New York	631 (37)	811 (32)	REF
Arkansas	41 (2.4)	172 (6.8)	3.18 *
Florida	676 (39)	977 (39)	1.19
Massachusetts	139 (8.3)	236 (9.5)	1.35 *
Maryland	75 (4.6)	54 (2.1)	0.65 *
Wisconsin	148 (8.7)	270 (11)	1.45 *

Table 4. Frequency of SNF vs. IRF discharges by state. Predictably, most patients were treated in states with the highest populations. Odds ratios for IRF discharge, after adjusting for characteristics in Table 1, significantly differed across states, indicating regional variation in discharge patterns. Asterisk (*) indicates significance (p<0.05).

Policy Implications

Demonstration of both:

- cost-savings •
- care-quality improvement

suggests opportunity to incentivize payors to provide IRF access for SCI

Quantification of costeffectiveness of IRF care may:

- compel increased triage to IRF
- induce increased investment in number of IRF facilities
- exert downward pressure on cost of IRF via market forces
- motivate a subsidy for IRF care and/or investment in low-access geographies

Leading the way to better care