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Post Acute Traumatic Brain Injury Rehabilitation

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Field Milestones

- Field begins mid to late '70s.
- Growth through the '80s & '90s.
- Peak ~1,200 post-acute facilities.
- CARF/JCAHO accreditation.
- DoD/VA – 5 Polytrauma Transitional Rehabilitation Programs.
 - Palo Alto
 - Minneapolis
 - Richmond
 - San Antonio
 - Tampa

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Characteristics of Facility-based Community Integration Programs for People With Brain Injury

*Mel B. Glenn, MD; Richard Goldstein, PhD;
Elizabeth A. Selleck, MPH; Michelle Rotman, BS*

There is considerable variability among programs with respect to quantifiable characteristics of facility-based community integration programs. Future studies should explore which characteristics affect outcomes. **Key words:** *brain injury, community integration, outpatient, postacute rehabilitation*

Terminology

Labels

- Postacute rehabilitation
- Postacute brain injury rehabilitation (PABI)
- Community re-entry
- Community-based rehabilitation
- Residential rehabilitation
- Transitional living

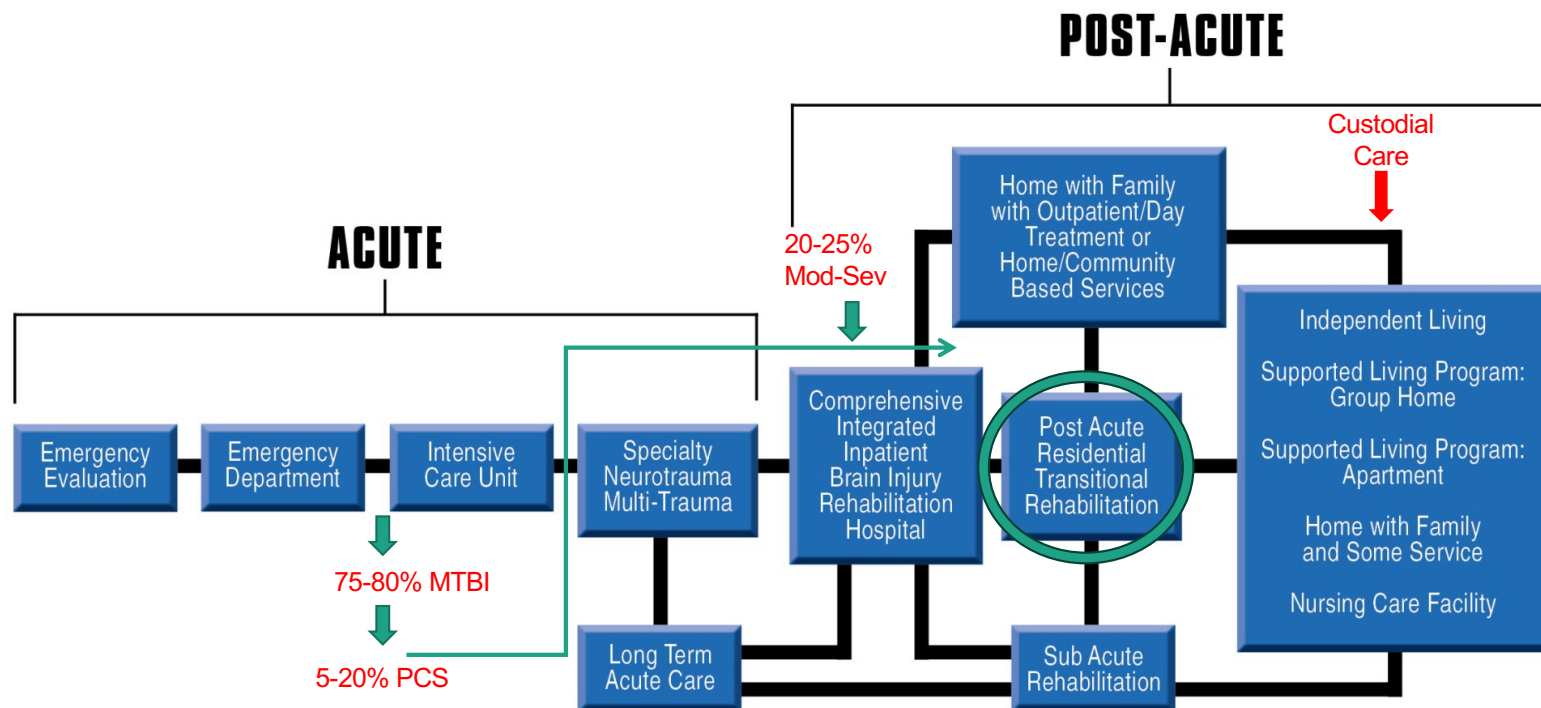
Settings

- Inpatient Rehabilitation Facility
- Outpatient clinic
- Residential setting
- In-home mentoring
- Day treatment
- Home & Community
- Ranches
- Skilled nursing
- Home health

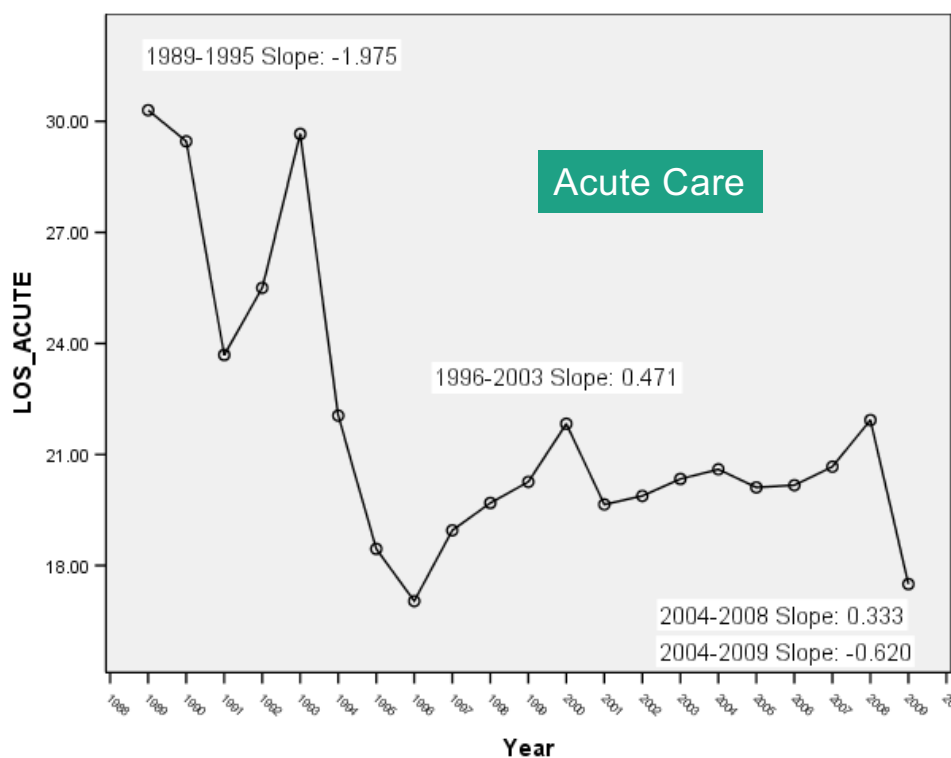
CONTINUUM OF CARE

(adapted from the Rocky Mountain Regional Brain Injury Systems)

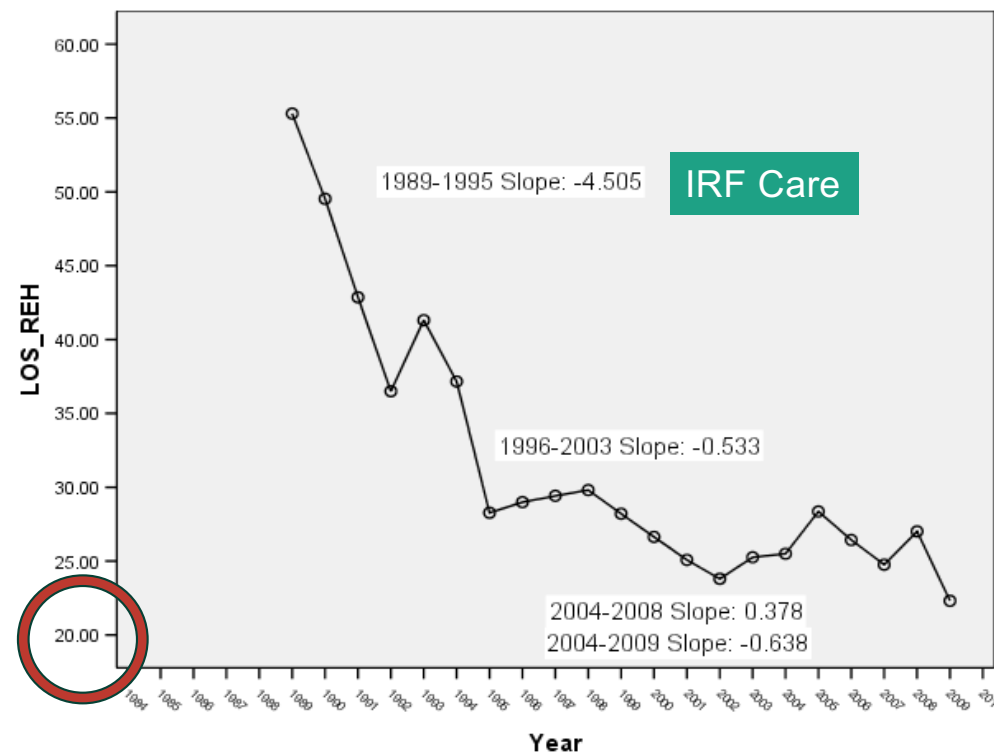
NIH Consensus Statement Online. Rehabilitation of persons with traumatic brain injury., Oct 26-28, 1998; **16: 1-41**.
Ashley, M. J. , *Brain Injury Source* 2010, 7(1): 11-21.



Length of Stay – TBI-Model Systems data



Acute Medical Care
1988 - 2009

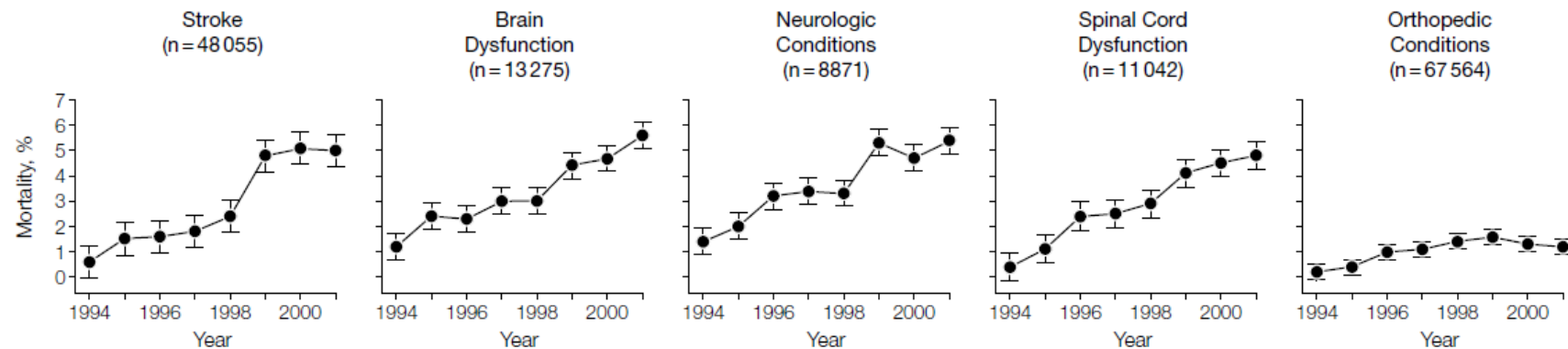


Inpatient Rehabilitation Care
1984 - 2009

Deaths after Discharge from Medical Rehabilitation

Mortality increased from 0.9% (1994) to 4.7% (2001)

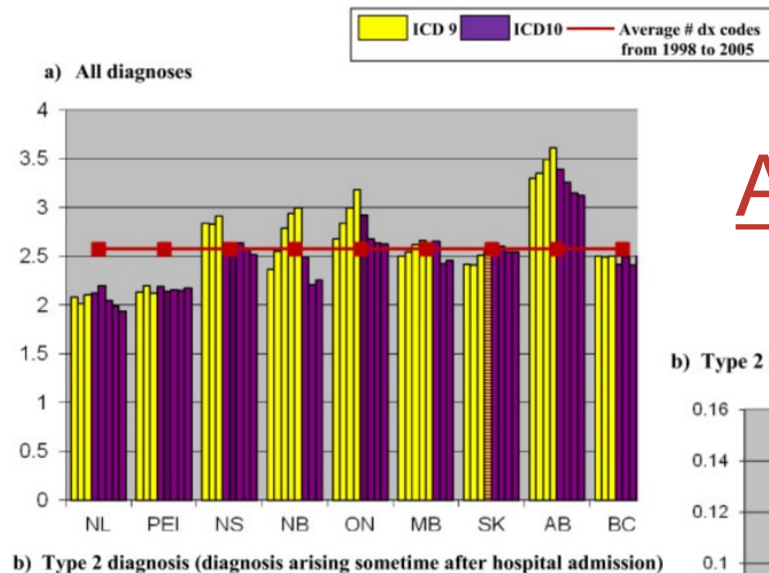
Figure. Changes in Percentage of Persons Who Died After Discharge From Medical Rehabilitation, 1994-2001, in 5 Impairment Groups



The trend in mortality was statistically significant for all impairment groups after adjustment for the following covariates: age, marital status, sex, race/ethnicity, whom living with, payment source, comorbidities, length of stay, and admission Functional Independence Measure scores: stroke ($F = 53.4$; $P < .001$); brain dysfunction ($F = 41.6$; $P < .001$); neurologic conditions ($F = 35.3$; $P < .001$); spinal cord injury ($F = 42.1$; $P < .001$); and orthopedic conditions ($F = 17.7$; $P = .003$). Error bars indicate standard error.

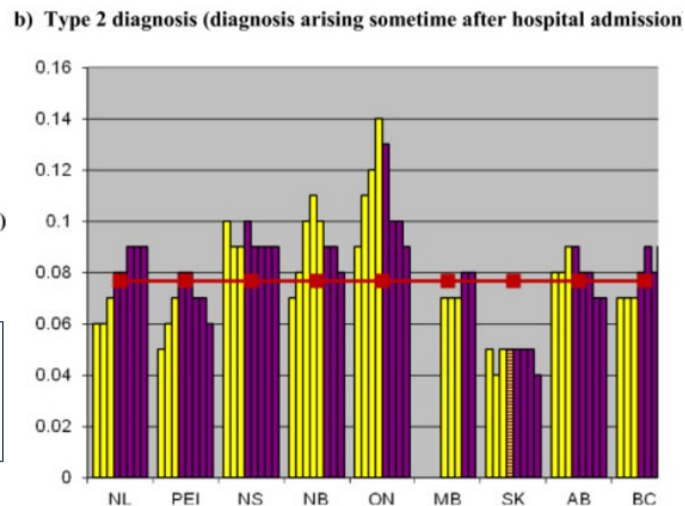
Ottensbacher K. et al (2004). *JAMA: The Journal of the American Medical Association*, 292(14), 1687-1695.

Mean ICD 10 Codes per Hospitalization – Non-TBI

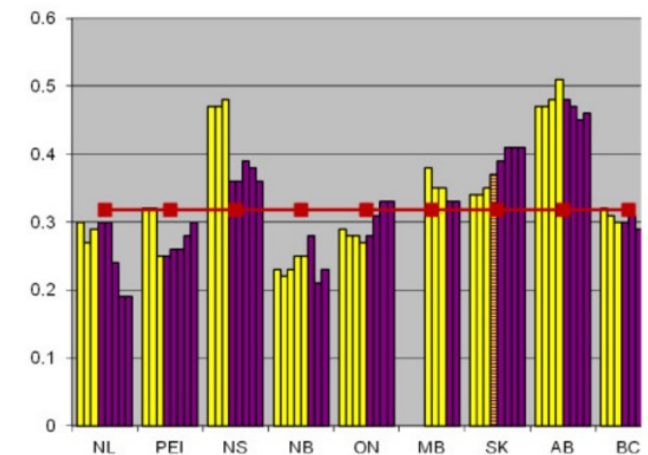


Average < 3

b) Type 2 diagnosis (diagnosis arising sometime after hospital admission)



c) Type 3 diagnosis (secondary diagnosis, present at hospital admission)



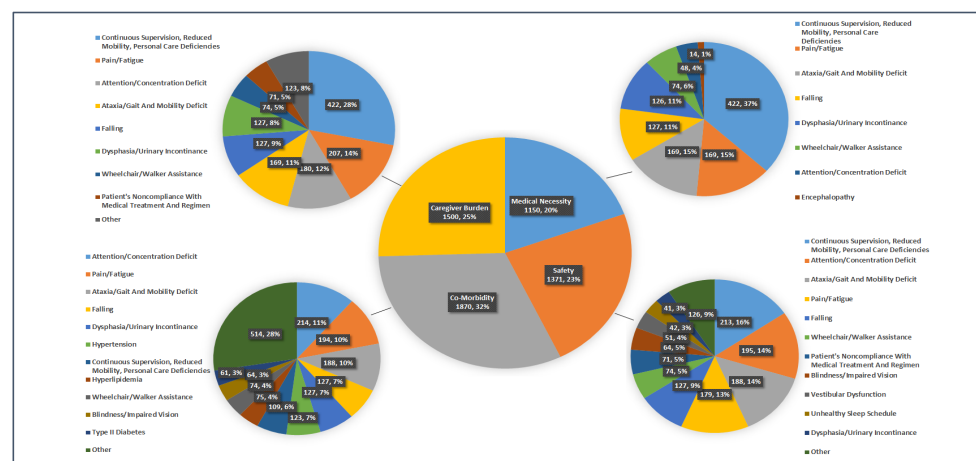
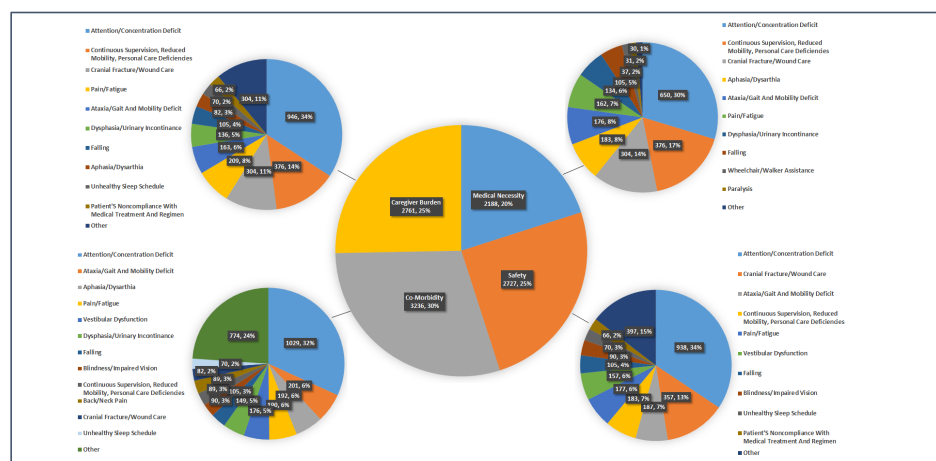
Walker, RL et al (2012) Implementation of ICD-10 in Canada: how has it impacted coded hospital discharge data? BMC Health Serv Res 12:149.

Average number of diagnosis codes per hospital visit by province and diagnosis type: fiscal years 1998 to 2005.

Stroke & TBI Patient – ICD-10 Codes at Post-Acute Admission

Total Stroke Patients	Avg. # of Codes/Patient
156	28.3

Total TBI Patients	Avg # of Codes/Patient
206	24.6





EFFICACY & OUTCOMES

PABI Community-Based & Outpatient Treatment

Cochrane Review RCT-Based Evidence
&
NSF Typology Non-RCT-Based Evidence



- There is strong evidence that community-based rehabilitation (transitional living units, day treatment, outpatient, home and community) improves productivity (employment) and reduces long-term supervision requirements.
- There is moderate evidence that community-based rehabilitation (transitional living units, day treatment, outpatient, home and community) reduces institutionalization.
- There is moderate evidence that outpatient treatment sustains gains made in inpatient rehabilitation.
- There is strong evidence that late rehabilitation can result in significant functional gains 5 to 10 years post injury.
- There is indicative evidence that late outpatient rehabilitation can be effective at least one year post stroke.

Turner-Stokes, L. (2008) Evidence for the effectiveness of multidisciplinary rehabilitation following acquired brain injury: a synthesis of two systematic approaches. J Rehab Med 40:691-701

PABI Specialist Rehabilitation



- There is strong evidence that intensive rehabilitation leads to earlier functional gains.
- There is strong evidence that intensive rehabilitation leads to reduced LOS in hospital and improved outcomes.
- There is strong evidence that specialist rehabilitation requires longer LOS, provides more intensive rehabilitation and results in more significant functional gains.
- There is moderate evidence that specialist rehabilitation reduces need for long-term support and increases long-term savings.
- There is limited evidence that specialist rehabilitation results in improved functional outcome, independence, and reduces caregiver stress.

Turner-Stokes, L. (2008) Evidence for the effectiveness of multidisciplinary rehabilitation following acquired brain injury: a synthesis of two systematic approaches. J Rehab Med 40:691-701

PABI Neurobehavioral Rehabilitation



- There is strong evidence that specialized neurobehavioral rehabilitation results in improved social behavior.
- There is moderate evidence that specialized neurobehavioral rehabilitation reduces needs for long-term support and increases long-term cost savings.
- There is moderate evidence that community-based rehabilitation (transitional living units, day treatment, outpatient, home and community) improves functional outcome after stroke.
- There is limited evidence that more intensive community-based rehabilitation (transitional living units, day treatment, outpatient, home and community) are more effective.

Turner-Stokes, L. (2008) Evidence for the effectiveness of multidisciplinary rehabilitation following acquired brain injury: a synthesis of two systematic approaches. J Rehab Med 40:691-701

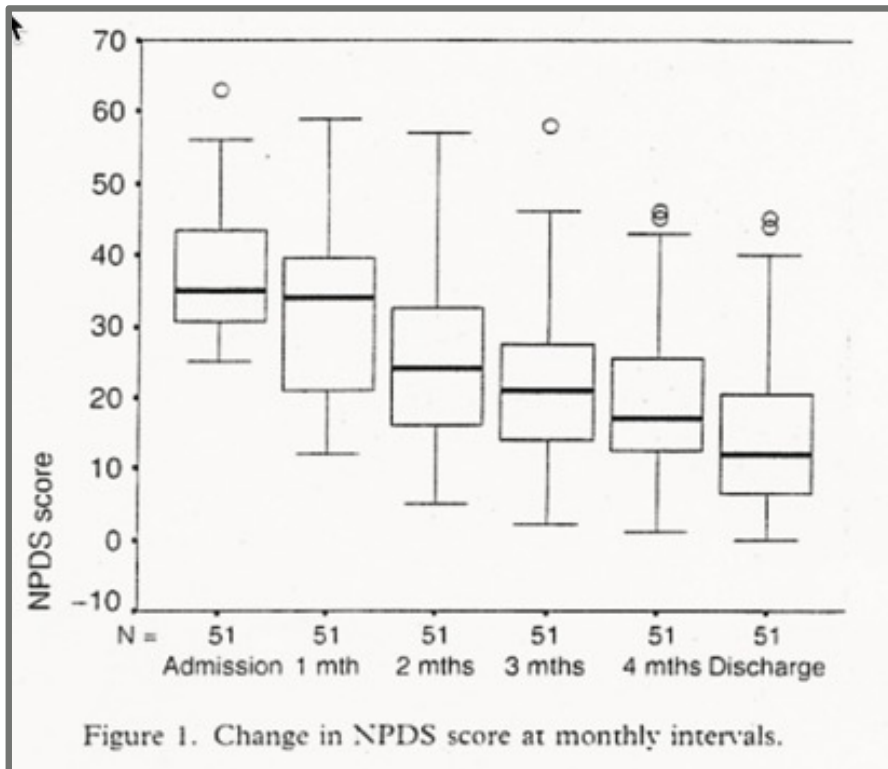
PABI Specialized Vocational Rehabilitation



- There is strong evidence that specialized vocational rehabilitation /work support programs increase rate of return to work.
- There is strong evidence that specialized vocational rehabilitation/work support programs are cost-effective to taxpayers.
- There is strong evidence that employment rates fall between 2 – 5 years post injury and that patients require long-term support to maintain gains in productivity (employment).
- There is strong evidence that patients continue to make gains in independence over the long-term following rehabilitation.

Turner-Stokes, L. (2008) Evidence for the effectiveness of multidisciplinary rehabilitation following acquired brain injury: a synthesis of two systematic approaches. J Rehab Med 40:691-701

Relationship between PABI LOS & Cost of Care



- 51 individuals with TBI
- Mean LOS ~ 6 months
- ↓
- Cost of rehabilitation was offset by savings in care costs in 14 months.

Turner-Stokes, L. (2007) Cost-efficiency of longer-stay rehabilitation programmes: Can they provide value for money?
Brain Injury 21(10) 1015-1021

PABI Rehabilitation Effects on Outcome and Costs

- 36 TBI subjects; 8 stroke subjects
- No benefit limitations from payer
- 3 blinded life care planners calculating comprehensive life care costs at admission and discharge.

TABLE 3. CRITERIA USED BY LIFE CARE PLANNERS TO DETERMINE PROJECTED COSTS

Categories

Nursing and attendant
 Medical/allied health services (consultations)
 Emergency services
 Medical procedures (diagnostic, laboratory and corrective)
 Medications (current and anticipated)
 Hospitalization (anticipated)
 Bed and accessories
 Durable medical equipment
 Bathing/hygiene needs
 Incontinence management
 Transportation
 Housing (room and board)/per diem charges
 Home care feeding supplies
 Miscellaneous
 One-time expenses
 Indemnity

TABLE 1. OUTCOME MEASURE SCORES OBTAINED DURING THE TIME OF ADMISSION

Admission Scores	TBI	CVA
DRS	8.14 ± 0.78	7.88 ± 0.93
OSS	13.69 ± 0.65	14.75 ± 0.16
LSS	5.19 ± 0.48	6 ± 1.02
MPAI-4	64.03 ± 2.86	58.38 ± 4.56
CIQ	11.09 ± 0.93	13.5 ± 2.98
CNS	47.08 ± 1.94	44.75 ± 2.86

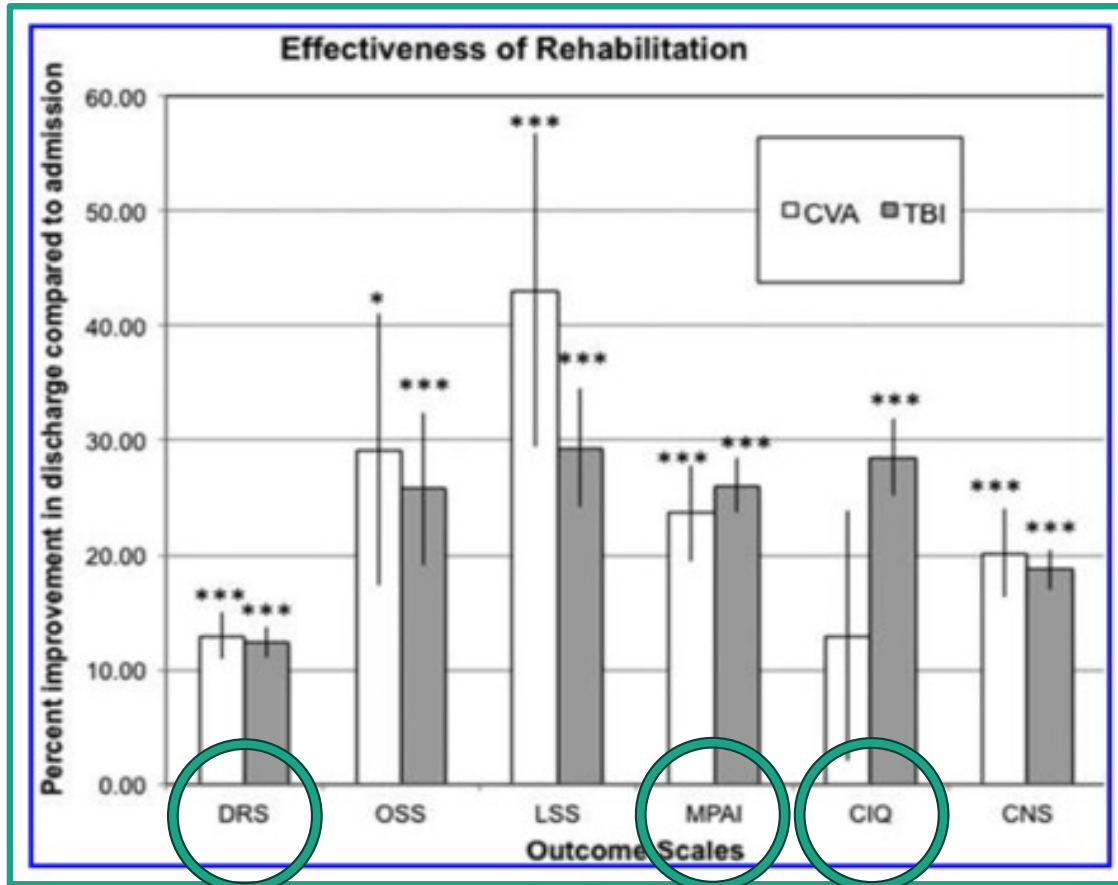
TABLE 2. PATIENT DEMOGRAPHIC DATA

Demographics	TBI	CVA
Age at injury (years)	Mean: 40.1 ± 11.8 SD Median: 40.0	Mean: 52.0 ± 14.5 SD Median: 56.0
Sex (male)	33 (91.7%)	5 (62.5%)
Housing (% inpatient)	30 (83.3%)	7 (87.5%)
Days of rehabilitation (days)	Mean: 227 ± 141.0 SD Median: 197.0	Mean: 203.9 ± 97.9 SD Median: 196.5 interval
Interval between injury and rehabilitation (days)	Mean: 285 ± 556.2 SD Median: 97.5	Mean: 135.1 ± 192.9 SD Median: 52.5
Previous acute rehabilitation	24 (66.7%)	7 (87.5%)
<i>Mechanism of injury</i>		
Motor vehicle accident	10 (27.8%)	
Pedestrian motor vehicle accident	2 (5.6%)	
Fall	20 (55.6%)	
Assault	1 (2.8%)	
Motor-bicycle accident	1 (2.8%)	
Blast (nonmilitary)	2 (5.6%)	

SD, standard deviation.

Griesbach, G. et al (2015) Post-Acute TBI Rehabilitation: Effects on Outcome Measures and Life Care Costs. J. Neurotrauma 32(10) 704-711.

TBI and CVA Post-Acute Rehabilitation Outcomes

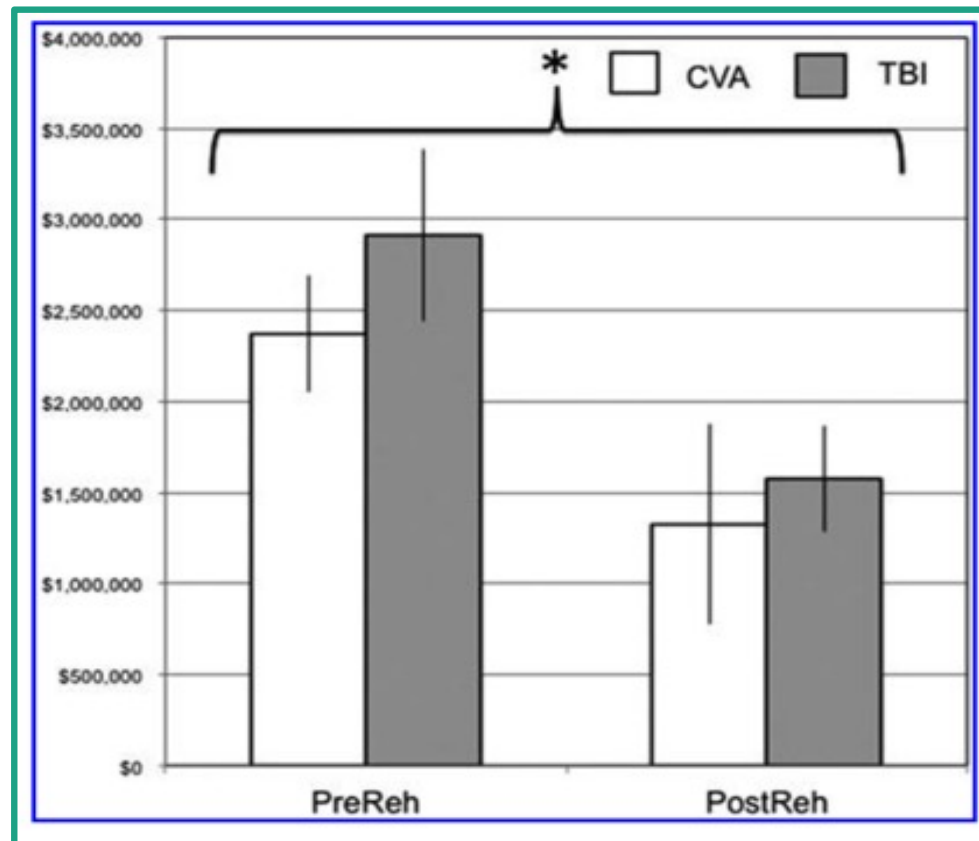


DRS – Disability Rating Scale
 MPAI – Mayo-Portland Adaptability Inventory
 CIQ – Community Integration Questionnaire

*** $p < 0.0005$

Griesbach, G. et al (2015) Post-Acute TBI Rehabilitation: Effects on Outcome Measures and Life Care Costs. J. Neurotrauma 32(10) 704-711.

Projected Life Care Costs Pre- & Post PABI Rehabilitation



Average reduction in
life care cost:

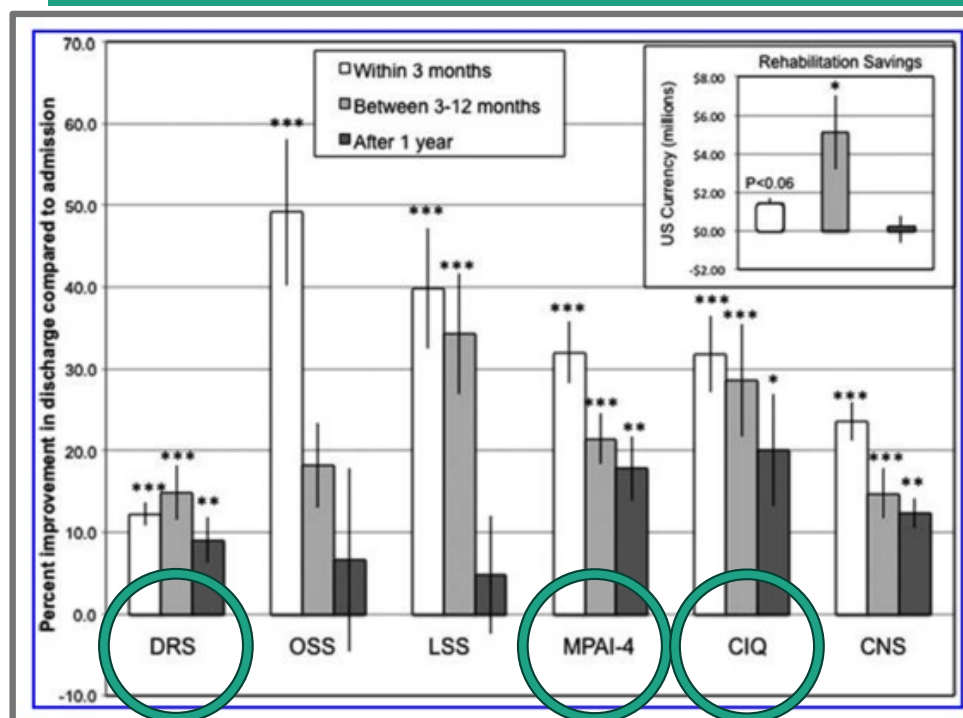
\$1,500,000

* $p > 0.05$

Griesbach, G. et al (2015) Post-Acute TBI Rehabilitation: Effects on Outcome Measures and Life Care Costs. J. Neurotrauma 32(10) 704-711.

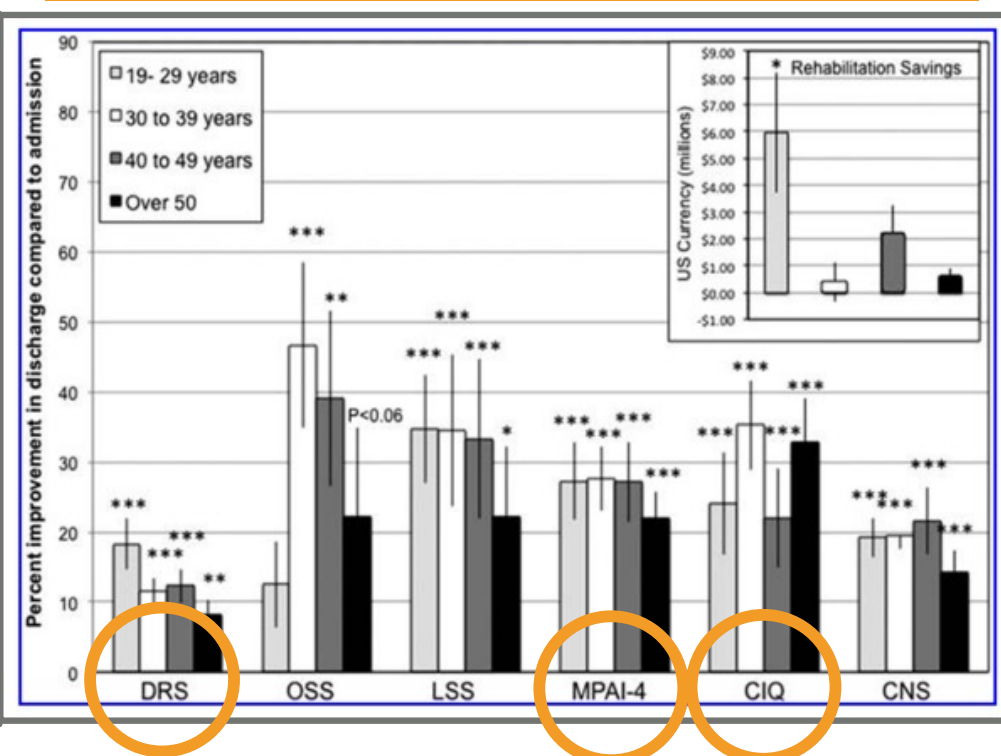
Effects of Latency & Age on TBI Rehabilitation Outcome

Injury to Admission Chronicity



* $p < 0.05$, ** $p < 0.005$, *** $p < 0.0005$

Age: 19 years to over 50 years



Griesbach, G. et al (2015) Post-Acute TBI Rehabilitation: Effects on Outcome Measures and Life Care Costs. J. Neurotrauma 32(10) 704-711.

Admission Disability Level, LOS & Outcome

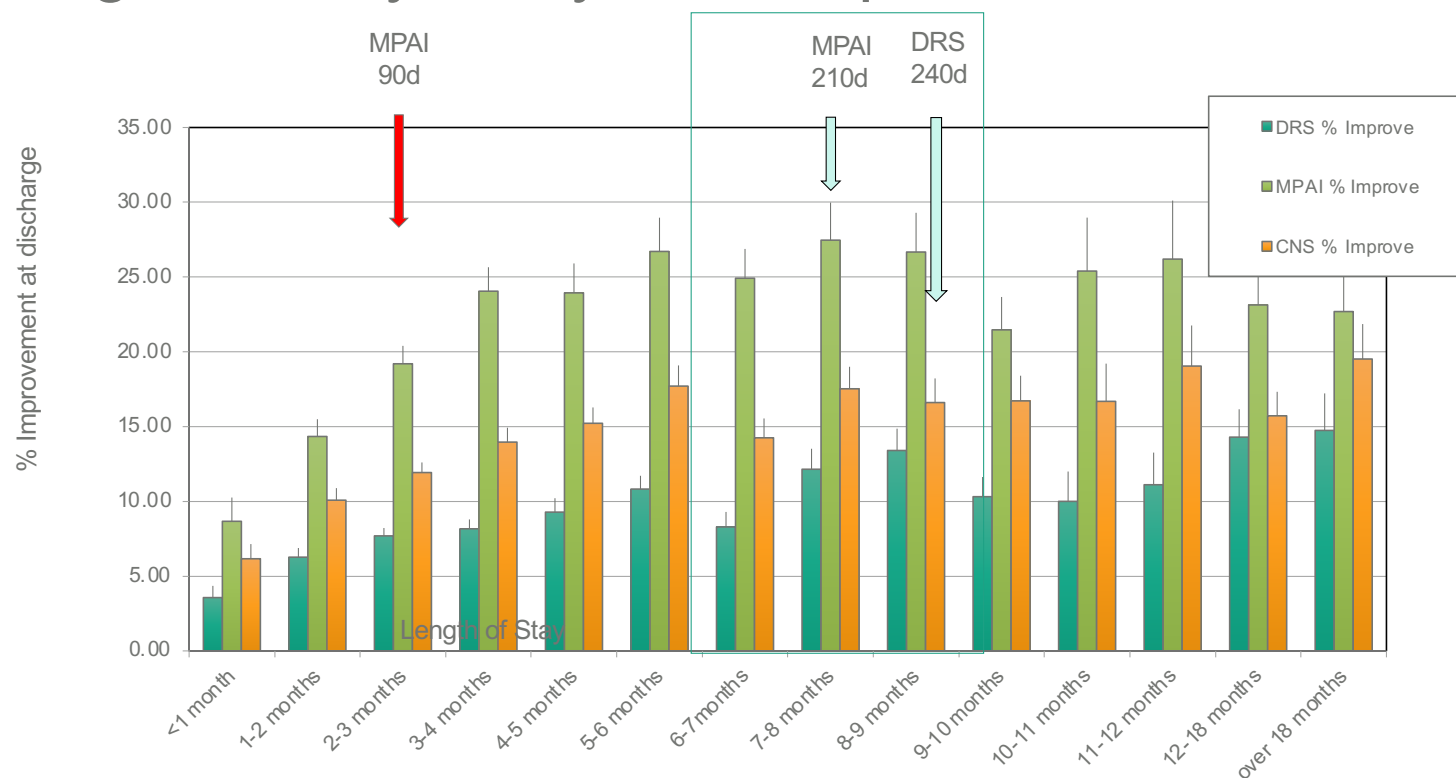
1,105 patient records, treated between 2006 & 2015.

1. Degree of functional improvement varied with level of disability at admission, chronicity, and length of stay.
2. Those with mild to moderate disability at admission and over 1 year chronicity showed improvement after 90 days.
3. Moderately and severely disabled individuals admitted between 3 months and 1 year chronicity showed improvements after 90 days.
4. Individuals with severe disability and over 1 year chronicity required at least 180 days of treatment.
5. Severely disabled individuals showed continued improvements after 180 days.

Disability Level	MPAI	CIQ
Mild LOS: 11-420 days	R Square: 0.10 $F(2,76) = 4.88, p < 0.05$	R Square: 0.06
Moderate LOS: 11-365 days	R Square: 0.05 $F(2,366) = 9.41, p < 0.0001$	R Square: 0.02 $F(2,364) = 4.21, p < 0.005$
Moderate LOS: 11-3,046 days	R Square: 0.06	R Square: 0.02 $F(2,395) = 3.22, p < 0.05$
Severe LOS: 38-1,320 days	R Square: 0.17 $F(2,82) = 8.29, p < 0.005$	R Square: 0.034

Ashley, J.G. et al. (2018) The influence of post-acute rehabilitation length of stay on traumatic brain injury outcome: a retrospective exploratory study. Brain Injury 38(5) 600-607

Length of Stay Analysis of Improvement for TBI Patients



Ashley, J.G. et al. (2018) The influence of post-acute rehabilitation length of stay on traumatic brain injury outcome: a retrospective exploratory study. *Brain Injury* 38(5) 600-607

Brain Injury Rehabilitation Legislation & Policy

2001 - Texas HB 1676

2008 - Texas HB 1919

2013 - Texas HB 2929

Two states have specialty license provisions for non-hospital post-acute brain injury treatment facilities (AR, LA).

77(R) HB 1676 Enrolled version - Bill Text

HB 1676

1-1 AN ACT
1-2 relating to health benefit plan coverage for certain benefits
1-3 related to brain injury.
1-4 BE IT ENACTED BY THE LEGISLATURE OF THE STATE OF TEXAS:
1-5 SECTION 1. Subchapter E, Chapter 21, Insurance Code, is
1-6 amended by adding Article 21.53Q to read as follows:
1-7 Art. 21.53Q. HEALTH BENEFIT PLAN COVERAGE FOR CERTAIN
1-8 BENEFITS RELATED TO BRAIN INJURY

By: Smith of Tarrant

H.B. No. 1919

H.B. 1919 ENTITLED

1 AN ACT
2 relating to health benefit plan coverage for treatment for certain
3 brain injuries.

By: Sheets

H.B. No. 2929

A BILL TO BE ENTITLED

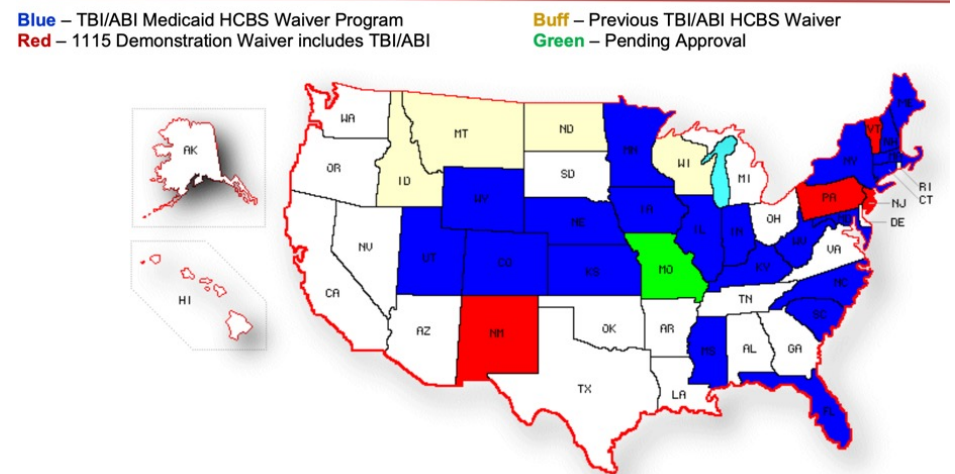
H.B.2929

1 AN ACT
2 relating to health benefit plan coverage for brain injury.

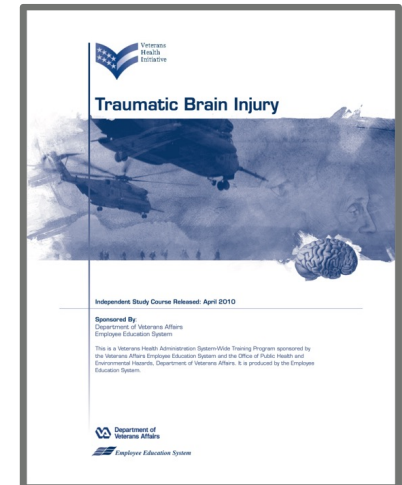
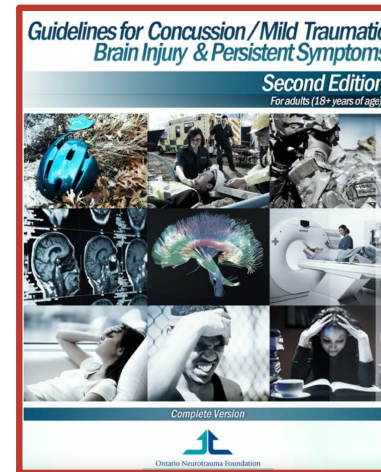
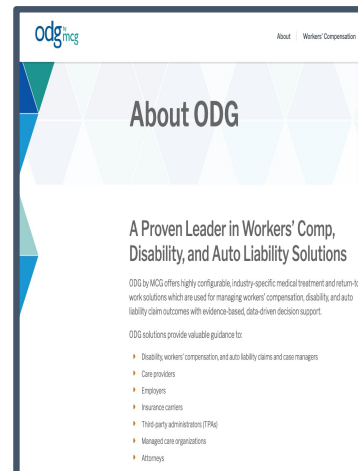
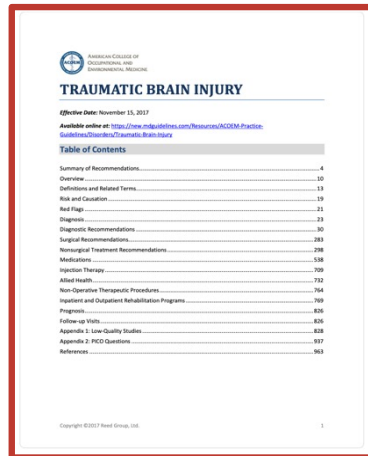
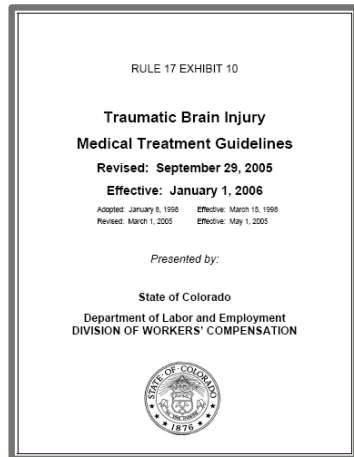
Medicaid 1915 HCBS Waiver Programs

- 2002 – 5,400 individuals received waiver funded services.
 - \$115 million.
- 2006 – 11,214 individuals received waiver funded services.
 - \$327 million.
- Medicaid brain injury waivers are intended to be used to maintain patients with brain injury in non-institutional community settings.

- States reported waiver programming was less expensive than institutionalization by almost \$273 million.



Post-Acute Rehabilitation in Payor Guidelines



Potential of Post-Acute Rehabilitation

- Participate in research delineating:
 - Identify different recovery trajectories for different diseases and disease severities.
 - Determination of individual terminal rehabilitation potential.
 - Disease differentiation and specification.
 - Neurodegenerative disease mitigation.
 - Pharmacological interventions.
 - Lifelong disease management strategies.



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March 11-12, 2025

Thank You!