

Supplementary Online Content

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This supplementary material has been provided by the authors to give readers additional information about their work.

eTable 1. Progression of Consciousness in Acute Care and Inpatient Rehabilitation Following TBI

	All Patients (N=17683)
Change in consciousness during acute care¹	
Not following commands on initial ED evaluation ²	N=7624
No FC → Not FC	1205 (16)
No FC → FC	6342 (83)
No FC → Missing	77 (1)
Following commands on initial ED evaluation ³	N=5834
FC → Not FC	249 (4)
FC → FC	5506 (94)
FC → Missing	79 (1)
Missing initial ED evaluation	N=4225
Missing → Not FC	604 (14)
Missing → FC	3564 (84)
Missing → Missing	57 (1)
Change in consciousness during inpatient rehabilitation⁴	
Not following commands at rehabilitation admission ⁵	N=2058
No FC → Not FC	363 (18)
No FC → FC	1674 (81)
No FC → Missing	21 (1)
Following commands on rehabilitation admission ⁶	N=15412
FC → Not FC	51 (1)
FC → FC	15320 (99)
FC → Missing	41 (1)
Missing rehabilitation admission evaluation	N=213
Missing → Not FC	2 (1)
Missing → FC	38 (18)
Missing → Missing	173 (81)

Data are N (%). TBI, traumatic brain injury; GCS_M, Glasgow Coma Scale motor score; DRS_M, Disability Rating Scale motor score; ED, emergency department; FC, following commands (GCS_M=6, DRS_M=0).

1. Δ Emergency department GCS_M score to rehabilitation admission DRS_M score.
2. GCS_M <6 on initial emergency department evaluation.
3. GCS_M =6 on initial emergency department evaluation.
4. Δ Inpatient rehabilitation admission DRS_M score to rehabilitation discharge DRS_M score.
5. DRS_M >0 at inpatient rehabilitation admission.
6. DRS_M =0 at inpatient rehabilitation admission.

eTable 2. Predictors of Recovery of Consciousness During Inpatient Rehabilitation Following TBI†

Patient characteristic‡	AOR	<i>p</i>	95% Confidence Interval
Older Age at Injury		NS	
Sex (male)		NS	
Higher velocity injury cause ¹		NS	
Intraventricular hemorrhage	0.678	0.002	0.532, 0.863
Non-cortical brain injury		NS	
Cortical brain injury		NS	
Intracranial mass effect ²	0.759	0.027	0.595, 0.968

TBI, traumatic brain injury; AOR, adjusted odds ratio; NS, not significant.

†Persisting disordered consciousness is defined as failure to follow commands at time of discharge from inpatient rehabilitation.

‡Backward stepwise logistic regression (N=1,868 in model).

1. Motor vehicle collision.

2. Midline shift or compression of basal cisterns.

eTable 3. Comparison of Patient Characteristics and Rehabilitation Admission Disordered Consciousness with Functional Independence at Discharge

	Functional Outcome at Time of Rehabilitation Discharge					
	Dependent on Assistance ¹		Semi-Independent ²		Independent ³	
	Not Following Commands at Rehabilitation Start n=1210 59% of NFC	Following Commands at Rehabilitation Start n=3144 20% of FC	Not Following Commands at Rehabilitation Start n=494 24% of NFC	Following Commands at Rehabilitation Start n=5564 36% of FC	Not Following Commands at Rehabilitation Start n=309 15% of NFC	Following Commands at Rehabilitation Start n=6377 41% of FC
Patient Characteristics⁴						
Demographics						
Age (years at injury onset) ⁵	36 (23-55)	49 (29-69)	35 (23-51)	41 (25-59)	35 (24-49)	35 (23-50)
Sex (male)	888/1210 (73)	2194/3144 (70)	381/494 (77)	4028/5562 (72)	256/309 (83)	4841/6376 (76)
Injury cause						
MVC vs. other	672/1209 (56)	1328/3139 (42)	292/494 (59)	2810/5552 (51)	144/307 (47)	3205/6363 (50)
Fall vs. other	289/1209 (24)	1174/3143 (37)	110/494 (22)	1512/5561 (27)	73/309 (24)	1625/6375 (25)
Acute hospital characteristics						
Duration of acute care (days)	30 (20-42)	22 (11-34)	20 (15-28)	16 (9-25)	18 (12-25)	12 (8-20)
Craniotomy or craniectomy ⁶	385/973 (40)	816/2754 (30)	106/376 (28)	1172/4709 (25)	54/204 (26)	1028/4663 (22)
Radiographic characteristics						
IVH ³	540/1148 (47)	972/3017 (32)	161/461 (35)	1299/5386 (24)	66/264 (25)	1076/6006 (18)
Intracranial mass effect ⁶	654/1136 (58)	1357/3006 (45)	197/457 (43)	2129/5363 (40)	114/261 (44)	2157/5978 (36)
Cortical contusion ⁶	901/1148 (78)	1942/3020 (64)	335/461 (73)	3481/5385 (65)	189/264 (72)	3798/6007 (63)
Non-cortical contusion ⁶	416/1146 (36)	714/3020 (23)	136/461 (30)	1008/5386 (19)	45/264 (17)	899/6002 (15)
Functional Characteristics⁷						
Admission FIM Total	18 (18-21)	31 (22-44)	23 (18-33)	51 (36-63)	38 (22-59)	70 (56-82)
Discharge FIM Total	46 (23-66)	68 (55-75)	89 (84-93)	90 (85-95)	109 (104-114)	110 (105-115)
Δ FIM Total	+24 (+4 to +43)	+29 (+17 to +41)	+63 (+54 to +70)	+39 (+28 to +53)	+71 (+50 to +84)	+40 (+29 to +53)
PTA emergence	288/1166 (25)	1854/3034 (61)	323/478 (68)	4767/5389 (88)	254/299 (85)	5912/6119 (97)

Data are N (%), median (IQR). NFC, not following commands; FC, following commands; MVC, motor vehicle collision; IVH, intraventricular hemorrhage; FIM, Functional Independence Measure; PTA, post-traumatic amnesia.

1. FIM Total Score 18-79
2. FIM Total Score 80-99
3. FIM Total Score 100-126
4. Excludes 213 patients with no Disability Rating Scale motor score at inpatient admission.
5. For 157 patients age ≥89 years, age was set at 89
6. Neuroanatomic data are incomplete for decade 1988-1998.
7. Data are for inpatient rehabilitation period.

eTable 4. Association of Patient and Clinical Characteristics with Functional Independence at Inpatient Rehabilitation Discharge in Patients with Disordered Consciousness at Start of Inpatient Rehabilitation

Patient Characteristics	Rehabilitation Discharge Function Independence Level			P	OR	95% CI
	All Patients ¹ (N=2058)	Dependent ² (n=1704)	Independent ³ (n=309)			
Demographics						
Age (years at injury onset) ⁴	35 (23-53)	35 (23-54)	35 (24-49)	0.218		
Sex (male)	1555/2053 (76)	1269/1704 (74)	256/309 (83)	0.002	1.656	1.208, 2.269
Race						
White	1393/2057 (68)	1,166/1703 (68)	201/309 (65)	0.672		
Black	358/2057 (17)	297/1703 (17)	54/309 (17)			
Asian/Pacific Islander	51/2057 (2)	41/1703 (2)	9/209 (3)			
Native American	9/2057 (1)	8/1703 (1)	1/209 (1)			
Hispanic	219/2057 (11)	170/1703 (10)	38/209 (12)			
Other	27/2057 (1)	21/1703 (1)	6/209 (2)			
Acute Clinical characteristics						
ED GCS Motor score ⁵						
6. Following commands	249/1454 (17)	190/1191 (16)	55/234 (23)	<0.001		
5. Localizes	247/1454 (17)	190/1191 (16)	52/234 (22)			
4. Withdraws	240/1454 (17)	193/1191 (16)	43/234 (18)			
3. Flexion	100/1454 (7)	85/1191 (7)	14/234 (6)			
2. Extension	109/1454 (7)	97/1191 (8)	10/234 (4)			
1. No response	509/1454 (35)	436/1191 (37)	60/234 (26)			
Sedated, paralyzed	530/1984 (27)	457/1648 (28)	65/299 (22)			
Unknown/missing	74/2058 (4)	56/1704 (3)	10/309 (3)			
ED GCS _M <6	1205/1454 (83)	1001/1191 (84)	179/234 (76)	0.005	1.619	1.153, 2.274
Injury cause						
MVC vs. other	1124/2050 (55)	964/1703 (57)	144/307 (47)	0.002	0.677	0.531, 0.864
Fall vs. other	487/2052 (24)	399/1703 (23)	73/309 (24)	0.941	1.011	0.760, 1.345
Acute hospital course characteristics						
Duration of acute care (days)	25 (17-36)	26 (18-38)	18 (12-25)	<0.001		
Craniotomy or craniectomy	559/1577 (35)	491/1349 (36)	54/204 (26)	0.006	0.629	0.452, 0.875
Radiographic characteristics						
Intracranial mass effect						
Compression or midline shift	984/1884 (52)	851/1593 (53)	114/261 (44)	0.003	0.676	0.519, 0.880
Midline shift >5mm	362/1884 (19)	324/1593 (20)	30/261 (11)	0.001	0.509	0.341, 0.758
IPH or IVH						
Punctate/petechial hemorrhage	557/1903 (29)	499/1609 (31)	52/264 (20)	<0.001	0.546	0.396, 0.752
IVH	770/1903 (40)	701/1609 (44)	66/264 (25)	<0.001	0.432	0.321, 0.580
Extra-axial fluid collection						
SAH or subdural	1630/1904 (86)	1397/1610 (87)	208/264 (78)	0.001	0.566	0.408, 0.786
Epidural	220/1900 (12)	186/1606 (12)	32/264 (12)	0.800	1.053	0.706, 1.571
Cortical contusion	1448/1903 (76)	1236/1609 (77)	189/264 (72)	0.065	0.760	0.568, 1.018
Subcortical contusion	603/1901 (32)	552/1607 (34)	45/264 (17)	<0.001	0.393	0.280, 0.550

Data are N (%), median (IQR). ED, emergency department; GCS, Glasgow Coma Scale; GCS_M, Glasgow Coma Scale motor score; MVC, motor vehicle collision; IPH, intraparenchymal hemorrhage; IVH, intraventricular hemorrhage; SAH, subarachnoid hemorrhage.

1. Disability Rating Scale motor score>0 (not following commands) at inpatient rehabilitation admission.
2. FIM Total Score 18-99 at rehabilitation discharge.
3. FIM Total Score 100-126 at rehabilitation discharge.
4. Age ≥89 years is set at 89.
5. Emergency Department GCS available for 1,984 (96%) patients.

eTable 5. Predictors of Functional Independence[†] at Rehabilitation Discharge in Patients with Disordered Consciousness[‡] at Start of Inpatient Rehabilitation

Patient characteristic ¹	AOR	<i>p</i>	95% Confidence Interval
Older Age at Injury	0.984	<0.001	0.976, 0.992
Sex (male)	1.641	0.005	1.157, 2.328
Higher velocity injury cause ¹	0.621	0.002	0.461, 0.836
Intraventricular hemorrhage	0.491	<0.001	0.360, 0.671
Non-cortical brain injury	0.448	<0.001	0.315, 0.639
Cortical brain injury		NS	
Intracranial mass effect ²	0.673	0.005	0.511, 0.886

TBI, traumatic brain injury; AOR, adjusted odds ratio; NS, not significant.

[†]Functional independence is FIM Total Score ≥ 100 at rehabilitation discharge

[‡]Disordered consciousness is failure to follow commands at time of inpatient rehabilitation admission.

1. Backward stepwise logistic regression (N=1,848 in model).

2. Motor vehicle collision.

3. Midline shift or compression of basal cisterns.

eTable 6. Predictors of Inpatient Rehabilitation Functional Outcome for Patients with Disordered Consciousness Following TBI†

Outcome and predictors‡	Unstandardized β	SE	Standardized β	<i>P</i>	95% CI for β	Adjusted R ²
Discharge FIM Total Score ¹						0.078
(Constant)	79.967	3.036		<0.001	74.013, 85.922	
Older age	-0.102	0.040	-0.063	0.011	-0.181, -0.023	
Sex (male)	3.971	1.586	0.056	0.012	0.862, 7.081	
Injury type (MVC)	-1.381	1.544	-0.022	0.371	-4.408, 1.647	
Intraventricular hemorrhage	-9.879	1.442	-0.159	<0.001	-12.706, -7.051	
Midline shift or cistern compression	-8.722	1.395	-0.143	<0.001	-11.458, -5.987	
Subcortical contusion	-8.658	1.530	-0.132	<0.001	-11.658, -5.657	
Cortical contusion	-1.839	1.635	-0.026	0.261	-5.046, 1.368	
Δ FIM Total Score ²						0.046
(Constant)	49.516	2.735		<0.001	44.153, 54.880	
Older age	-0.132	0.036	-0.094	<0.001	-0.203, -0.061	
Sex (male)	2.755	1.424	0.045	0.053	-0.038, 5.547	
Injury type (MVC)	1.216	1.390	0.023	0.381	-1.509, 3.942	
Intraventricular hemorrhage	-5.041	1.300	-0.093	<0.001	-7.591, -2.492	
Midline shift or cistern compression	-6.605	1.254	-0.124	<0.001	-9.063, -4.146	
Subcortical contusion	-6.230	1.378	-0.109	<0.001	-8.932, -3.527	
Cortical contusion	0.254	1.471	0.004	0.863	-2.631, 3.139	

TBI, traumatic brain injury; FIM, Functional Independence Measure; MVC, motor vehicle collision.

†Disordered consciousness is defined as failure to follow commands at time of inpatient rehabilitation admission.

‡Multivariable linear regression.

1. Assessed at time of inpatient rehabilitation discharge (N=1,848 in model).

2. Change in FIM Total score between rehabilitation admission and rehabilitation discharge (N=1,800 in model).

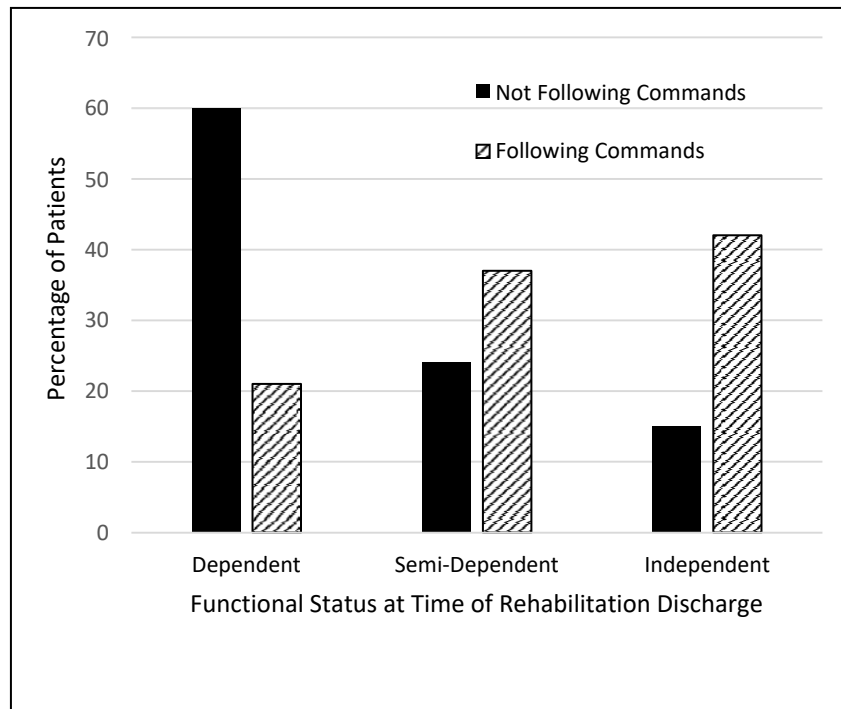
eTable 7. Comparison of Patient, Injury and Outcome Characteristics by Decade in Disordered Consciousness Following TBI

	Injury Year					
	1988 to 1998		1999 to 2009		2010 to 2019	
	Not Following ¹ Commands n=173 14%	Following Commands ¹ n=1056 86%	Not Following Commands ¹ n=1146 14%	Following Commands ¹ n=6936 86%	Not Following Commands ¹ n=739 9%	Following Commands ¹ n=7420 91%
Patient Characteristics ²						
Demographics						
Age (years at injury onset) ³	34 (23-43)	32 (23-43)	34 (22-51)	37 (23-53)	38 (25-58)	44 (27-61)
Sex (male)	134/173 (77)	801/1056 (76)	866/1146 (76)	5095/6935 (73)	555/734 (76)	5403/7417 (73)
Injury cause						
MVC vs. other	72/172 (42)	514/1053 (49)	683/1145 (60)	3740/6925 (54)	369/733 (50)	3273/7401 (44)
Fall vs. other	17/172 (10)	145/1056 (14)	243/1146 (21)	1650/6931 (24)	227/734 (31)	2584/7417 (35)
Acute hospital characteristics						
Duration of acute care (days)	24 (16-41)	16 (9-26)	25 (17-36)	16 (9-25)	24 (17-35)	15 (8-25)
Craniotomy or craniectomy ⁴	1/5 (20)	4/17 (24)	295/847 (35)	1179/4887 (24)	263/725 (36)	1875/7395 (25)
Radiographic characteristics ⁴						
IVH	24/85 (28)	93/693 (13)	477/1125 (42)	1562/6798 (23)	269/693 (39)	1760/7206 (24)
Intracranial mass effect	38/84 (45)	268/686 (39)	611/1108 (55)	2794/6747 (41)	335/692 (48)	2685/7197 (37)
Cortical contusion	56/85 (66)	407/693 (59)	860/1125 (76)	4409/6798 (65)	532/693 (77)	4593/7209 (64)
Non-cortical contusion	22/85 (26)	102/693 (15)	362/1124 (32)	1227/6797 (18)	219/692 (32)	1333/7205 (19)
Outcome Characteristics ⁵						
Admission FIM Total	23 (18-44)	58 (37-79)	20 (18-27)	57 (37-73)	18 (18-26)	52 (35-67)
Discharge FIM Total	90 (59-105)	106 (92-114)	73 (39-91)	98 (85-109)	66 (32-85)	92 (80-104)
Δ FIM Total	+46 (+24 to +68)	+41 (+27 to +57)	+44 (+16 to +62)	+37 (+27 to +61)	+39 (+13 to +58)	+37 (+27 to +49)
Functionally independent ^{6,7}	59/165 (36)	623/996 (63)	178/1129 (16)	3210/6777 (47)	72/719 (10)	2544/7312 (35)
PTA emergence	79/158 (50)	752/936 (80)	501/1102 (45)	5692/6643 (86)	302/716 (42)	6347/7254 (87)

Data are N (%), median (IQR). MVC, motor vehicle collision; IVH, intraventricular hemorrhage; FIM, Functional Independence Measure; PTA, post-traumatic amnesia.

1. Disability Rating Scale motor score at time of inpatient rehabilitation admission.
2. Excludes 213 patients with no Disability Rating Scale motor score at inpatient rehabilitation admission.
3. Age >89 years is set at 89.
4. Neuroanatomic data are incomplete for decade 1988-1998.
5. Data are for inpatient rehabilitation period.
6. FIM Total Score 100-126.
7. Data exclude 372 patients with no discharge FIM total scores.

eFigure 1. Comparison of Disordered Consciousness at Inpatient Rehabilitation Admission and Functional Independence at Inpatient Rehabilitation Discharge



eFigure 2. Comparison of Change in Functional Status During Inpatient Rehabilitation

