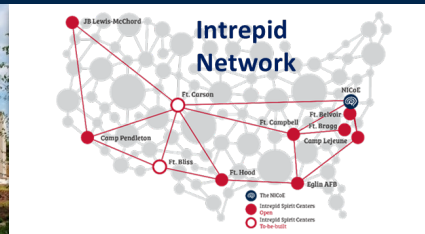




Efficacy of an Interdisciplinary Intensive Outpatient Program in Service Members with combat related mild Traumatic Brain Injury (TBI) and Psychological Health Conditions

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Chief Innovations Officer
National Intrepid Center of Excellence

21 April 2021



Disclosure

The reviews expressed in this presentation are those of the presenter and do not reflect the official policy of the Department of Defense or the U.S. Government.

Objectives

- Characterize the service member population for TBI and PH comorbidities. Congressional mandate for a Center of Excellence
- Describe the principles of a holistic Interdisciplinary Intensive Outpatient Program (Proof of Concept)
- Present effects of IOP implementation assessing multi-domain outcome measures.
- Demonstrate the value of standardized interdisciplinary care as a research platform for precision TBI characterization and interventions
- Discuss the translation of the Interdisciplinary Model of care to the Defense Intrepid Network

TBI and Psychological Health Conditions: Physiological Response to Repetitive TBI and Operational Stressors

Concussive & Subconcussive exposure

- Combat – IED, breaching, boats, RPG, danger close drops
- Training – Breachers, Carl Gustav, combatives, parachute jumps, fast boats

Complex clinical conditions with TBI and Psychological Health Injury (PHI)

Chronic Operational Stress:

- Decreased cognitive bandwidth
- Sympathetic/parasympathetic imbalance
- Cerebral autonomic dysfunction



Blast Exposure



Can we relate the stress response to a physiological disturbance?

Can we modulate the stress response in a socially adaptive manner?



Walter Reed
National Military
Medical Center

Blast & Blunt Force Exposure



<https://www.defense.gov/>



Photo Courtesy Dept of Defense



<https://www.defense.gov/>

History of the NICoE and the Network

- The global war on terrorism resulted in thousands of service members suffering from combat-related traumatic brain injury (TBI) and behavioral health comorbidities
 - known as **the “invisible wounds of war”**
- Guided by recommendations from **blue ribbon panels**, the **National Defense Authorization Act (NDAA)** in 2008 directed the Department of Defense to establish a comprehensive plan for programs to prevent, diagnosis, treat and rehabilitate service members with TBI, PTSD and other mental health conditions
- Secretary of Defense Gordon England accepted the gift from the American People through the Intrepid Fallen Heroes Fund to build the NICoE, the “premier diagnosis, treatment and research center for TBI and psychological health.”
 - The Center opened on **June 24, 2010** as a proof-of-concept for a holistic interdisciplinary care model
- In keeping with the goal for dissemination of an effective model of care, the first Intrepid Spirit Center (ISC) at **Ft Belvoir** opened on **September 11, 2013**. Since then the network has grown to 11 sites – the NICoE and ten ISCs.

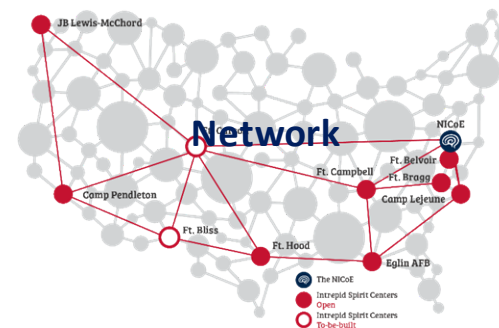


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Challenges with current classification & outcomes

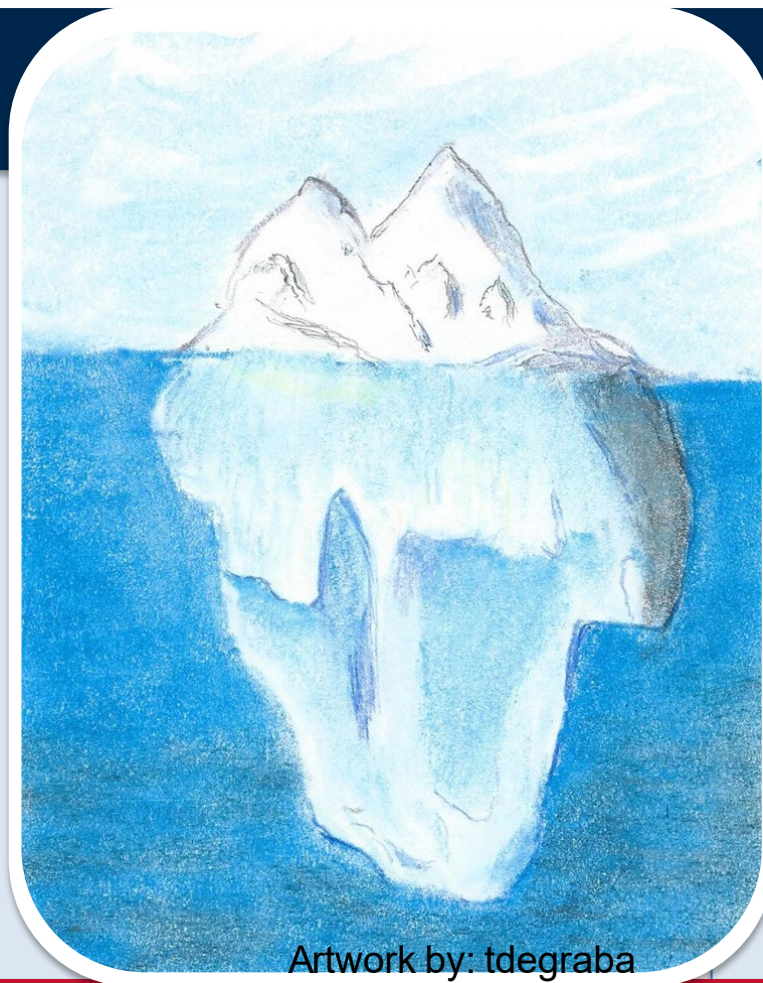
TBI CLASSIFICATION

GCS

MILD

MODERATE

SEVERE



Artwork by: tdegraba

TBI OUTCOMES

GOS-E

Good

Severe Disability

Dead

- **Develop a more precise system for TBI classification,**
- **Understand pathophysiology- Pharm & non-Pharm interventions,**
- **Develop predictive markers of recovery & outcomes**

The Interdisciplinary Care Model is the Foundation of the Network

- Establish a care paradigm that changes the conventional health care model in complex cases. Referral to multiple specialist, risks fragmented delivery of care.
- Proof of Concept: Holistic, patient centric, Interdisciplinary Intensive Outpatient Program (IOP) [4 week program]
- All service members (SMs) are referred by their primary care providers; not responding to conventional therapy. Team conducts intensive chart review.
- 1st day Interdisciplinary intake: PCP, Neurologist, Psychiatrist, Neuro-Psychologist, Family Therapist, and Nurse specialist who serves as a touch stone.
- The **patient is at the center of the care team**, enhancing patient-provider rapport, and enabling a more efficient identification of goals for recovery, and providing immediate feedback of response to treatment.
- Family members are encouraged to attend in the 4th week.
- In week 4, a “Warm Handoff” session with the Team Lead, home team PCP & case manager, SM & spouse

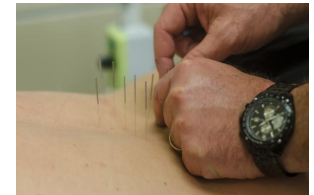
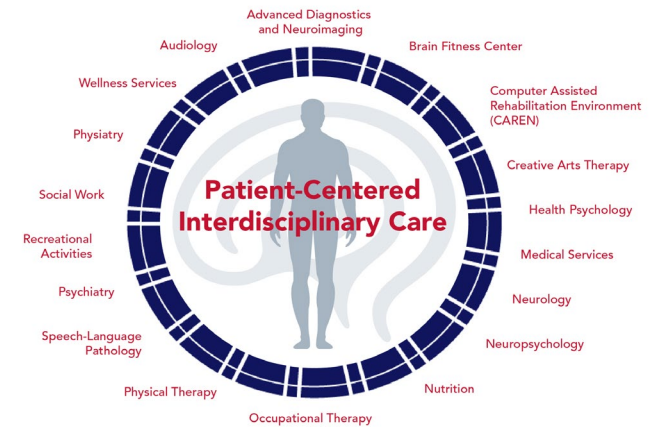


Photo & Graphics courtesy NICoE PAO



Interdisciplinary Intensive Outpatient Program (IOP) Fundamentals

- Four-week interdisciplinary, patient-centered, holistic IOP that uses **traditional rehabilitation, neurological, and BH treatments combined with integrative medicine interventions and skills-based training**
- Leverages the colocalization of a team comprising 17 disciplines to expedite diagnostic evaluation and to **build on each other's expertise to achieve** common goals and develop a **collaborative care plan**
- The rehabilitative culture encourages skills-based training for **self-efficacy and education modules for self-advocacy techniques to enhance sustainable recovery beyond program discharge**





NICoE: Collocation of Capabilities

- High Tech: Anatomical & Physiological

- Neuroimaging

- Magnetoencephalography
- 3 Tesla MRI
- PET/CT
- Transcranial Doppler

- Computer Assisted Rehabilitation Environment (CAREN)

- Sleep Study Center

- Vestibular & Audiology Testing

- High Touch : Integrative Medicine

- Creative Arts Therapies

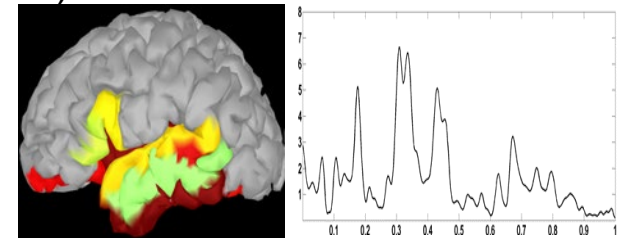
- Therapeutic Writing

- Yoga, Meditation, Imagery

- Biofeedback

- Acupuncture

- Animal Assistant Therapy

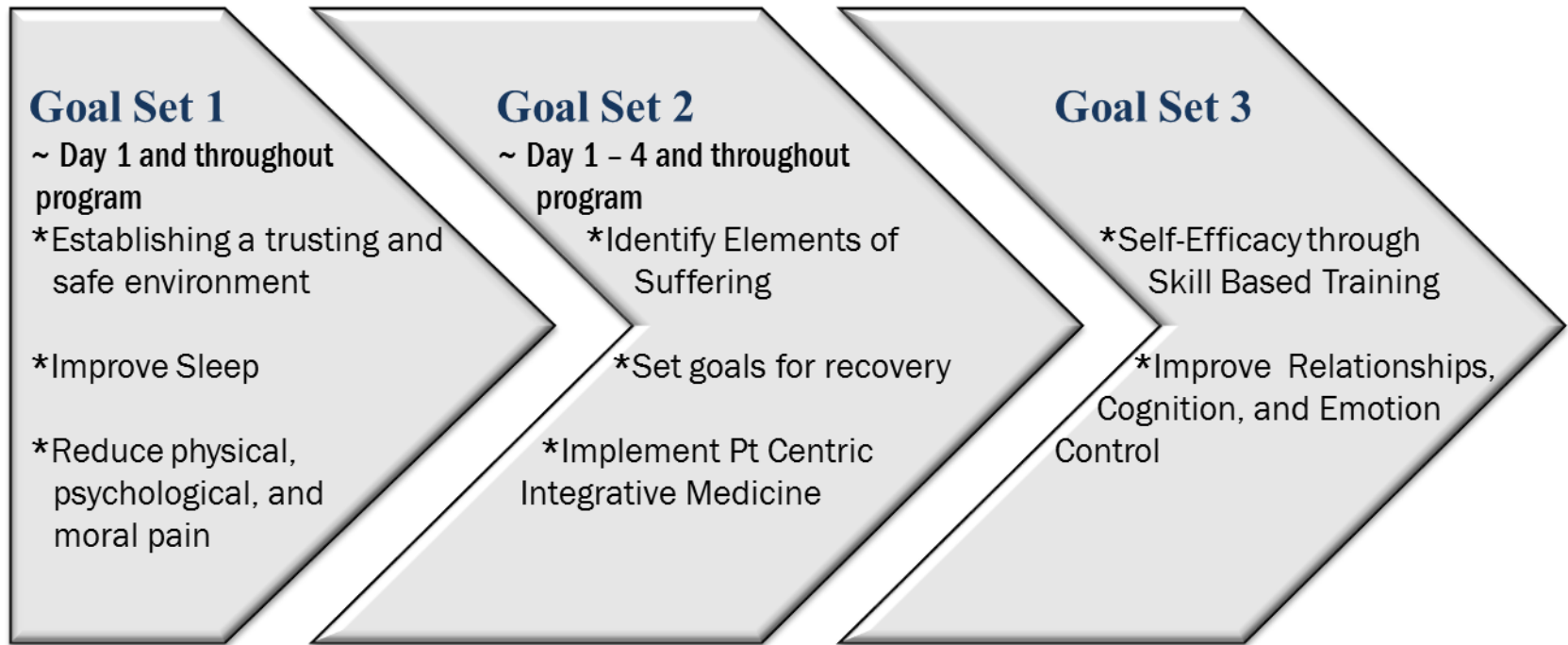


NICoE Evaluation and Treatment Activities Intensive Care Outpatient Model



- **4 Weeks**
- **Schedule is tailored to meet the needs of each service member**
- **105- 135 Total clinical care hours**

Sequenced Goal Sets



Overview of Goal Sets at NICoE During 4-Week Intensive Outpatient Program

Outcome Measures

Assessment	Measures	Symptomatic Range
Neurobehavioral Symptom Inventory (NSI)	Severity of post-concussion symptoms	No composite threshold
PTSD Checklist-Military (PCL-M)	DSM-IV symptoms of PTSD (military version)	≥35
Satisfaction With Life Scale (SWLS)	Global life satisfaction	≤19
Patient Health Questionnaire-8 (PHQ-8)	Mental disorders, functional impairment, and recent psychosocial stressors	≥5
Generalized Anxiety Disorder-7 (GAD-7)	Severity of generalized anxiety disorder	≥10
Epworth Sleepiness Scale (ESS)	Daytime sleepiness or average sleep propensity	>10
Headache Impact Test-6 (HIT-6)	Impact of headaches on ability to function	≥50

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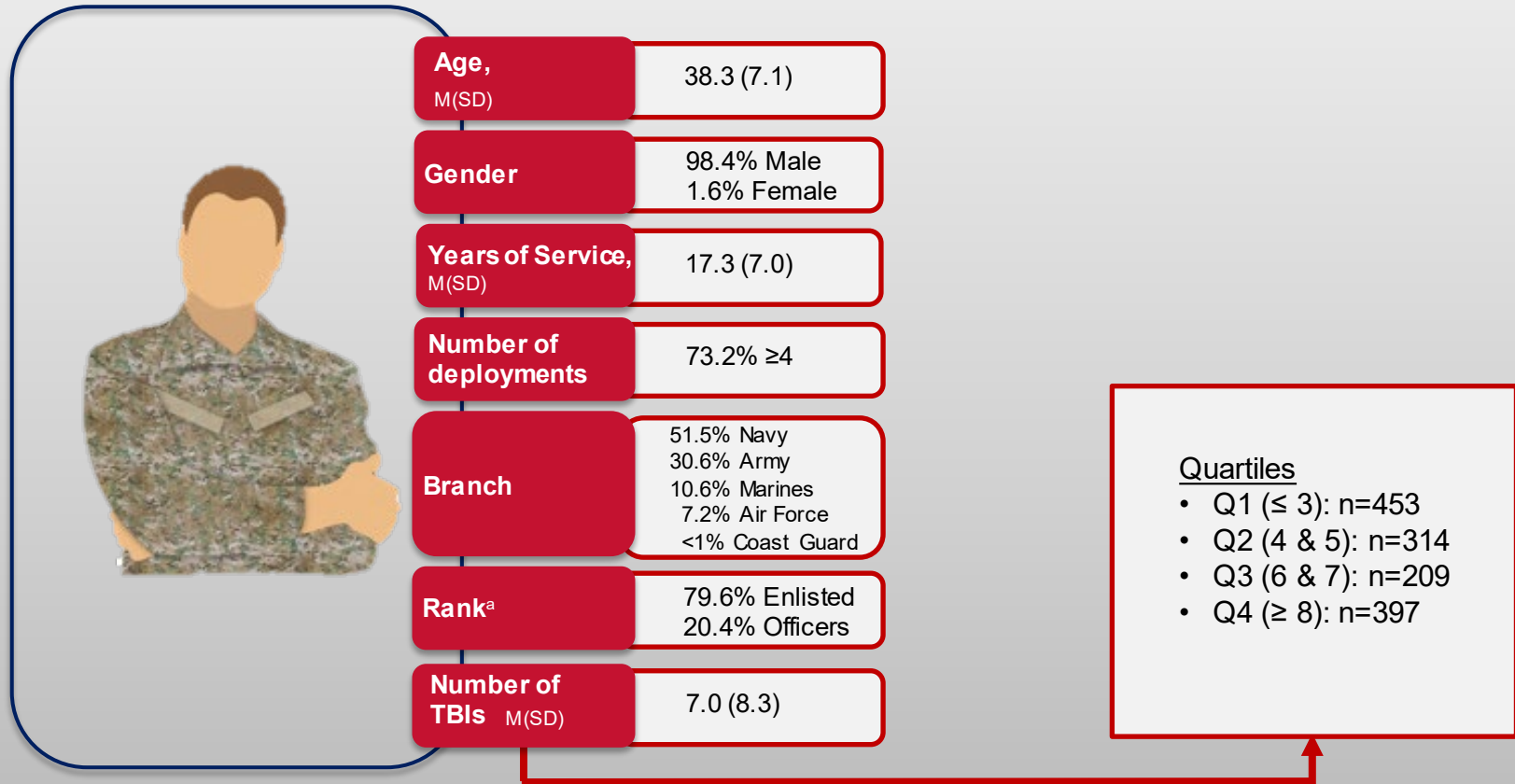
Outcome Measures

Assessment	Measures	Clinical Improvement Threshold
Neurobehavioral Symptom Inventory (NSI)	Severity of post-concussion symptoms	≥5-point change
PTSD Checklist-Military (PCL-M)	DSM-IV symptoms of PTSD (military version)	≥10-point change
Satisfaction With Life Scale (SWLS)	Global life satisfaction	≥5-point change
Patient Health Questionnaire-8 (PHQ-8)	Mental disorders, functional impairment, and recent psychosocial stressors	≥5-point change
Generalized Anxiety Disorder-7 (GAD-7)	Severity of generalized anxiety disorder	≥5-point change
Epworth Sleepiness Scale (ESS)	Daytime sleepiness or average sleep propensity	≥2-point change
Headache Impact Test-6 (HIT-6)	Impact of headaches on ability to function	≥8-point change

Outcome Measures

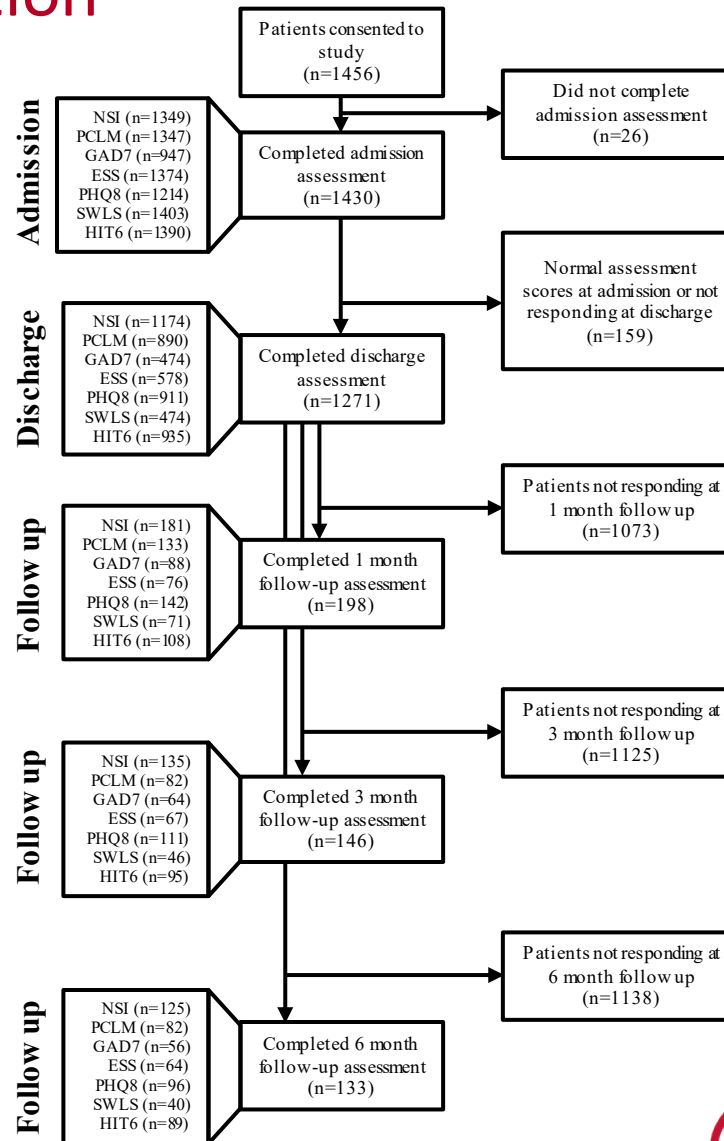
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Demographics for the study population (N=1,456)

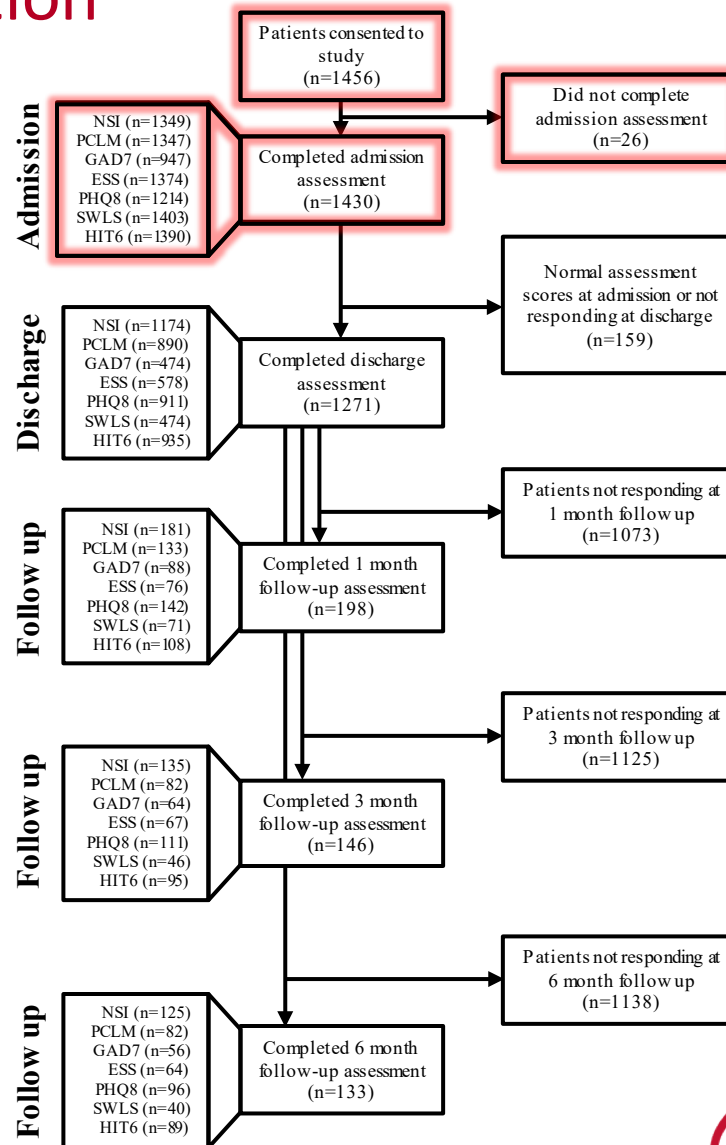


Additional demographics analyzed but not shown include: Marital Status, Ethnicity, & Mechanism of Injury
^aRank: Enlisted: E-3,4,5,6,7,8,9; Officer: W-1,2,3,4,5; O-1,2,3,4,5,6

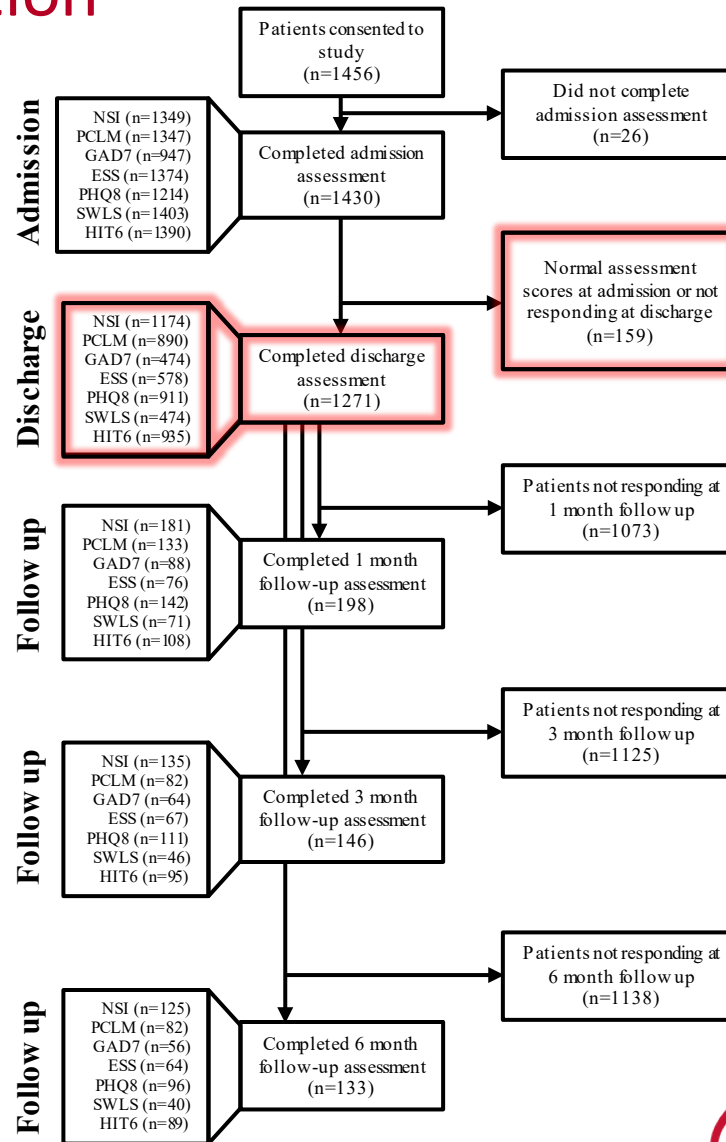
Patient Information



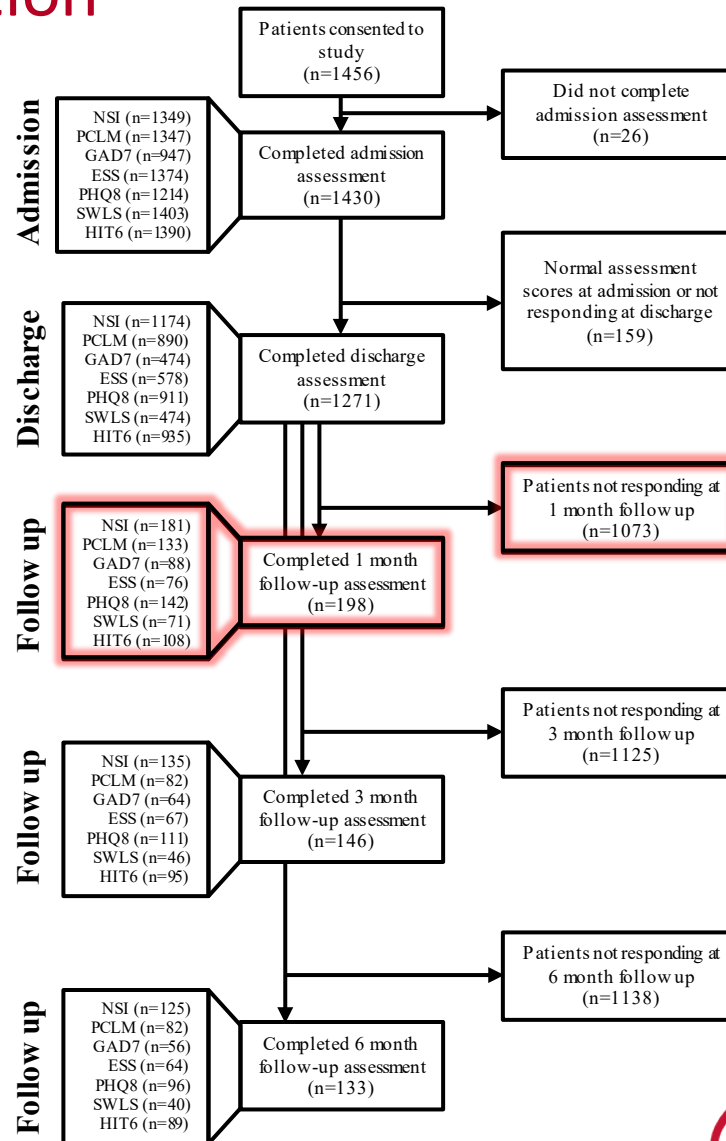
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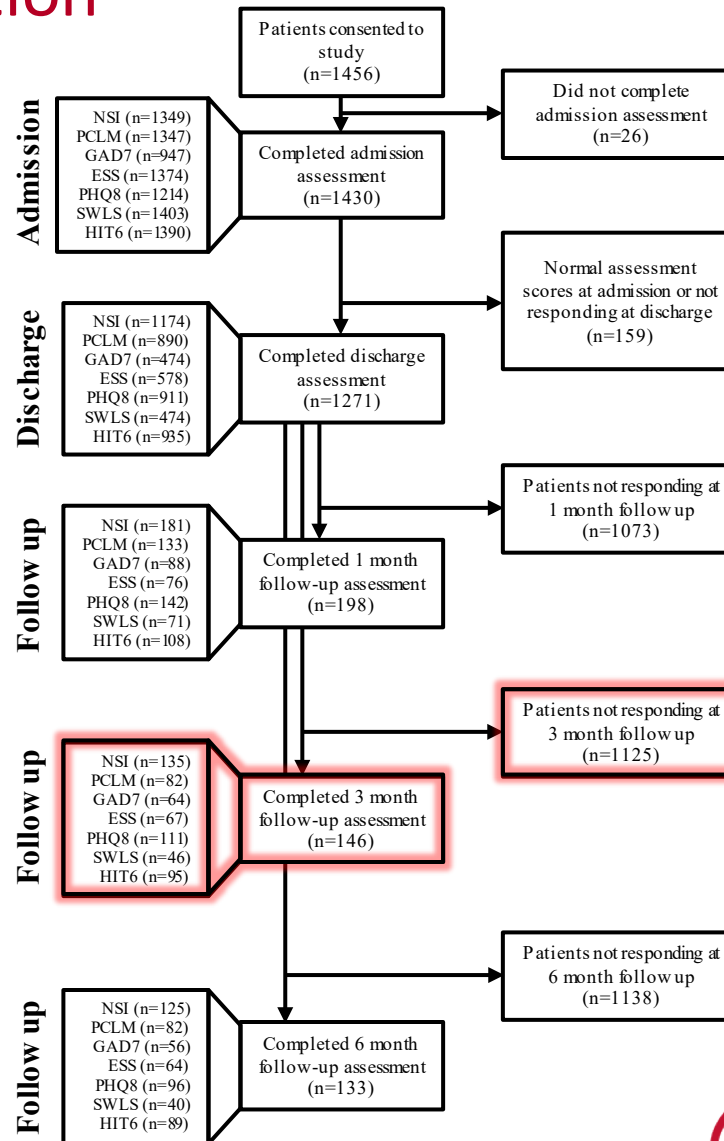
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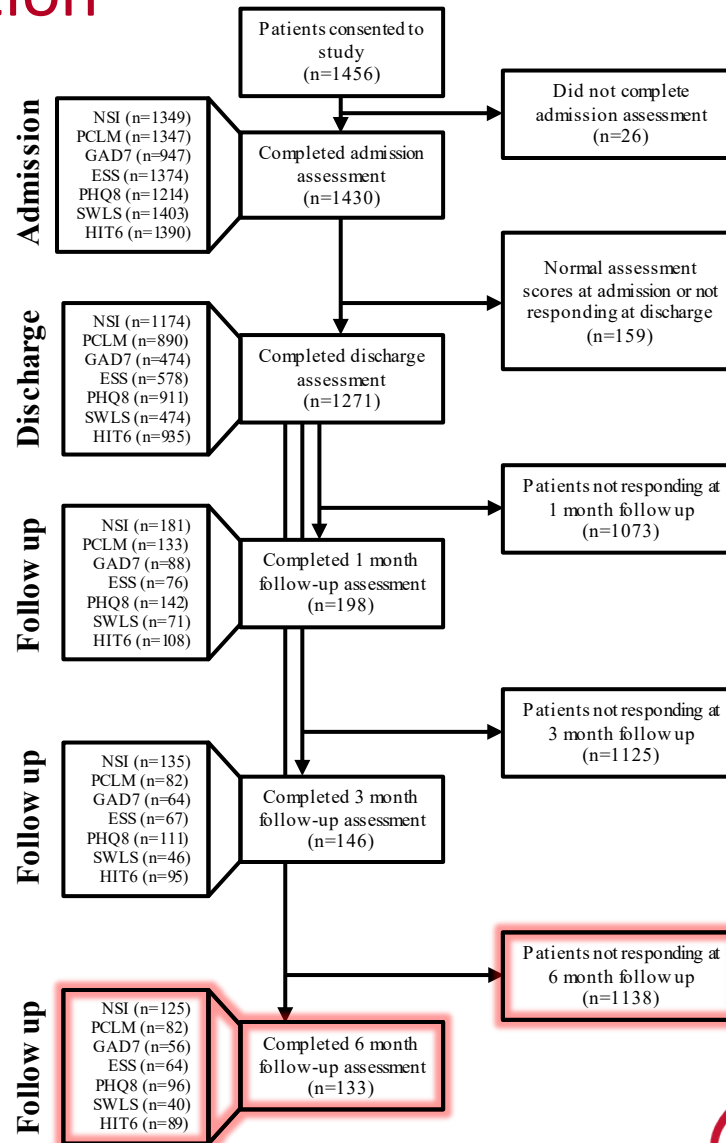
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Patient Information

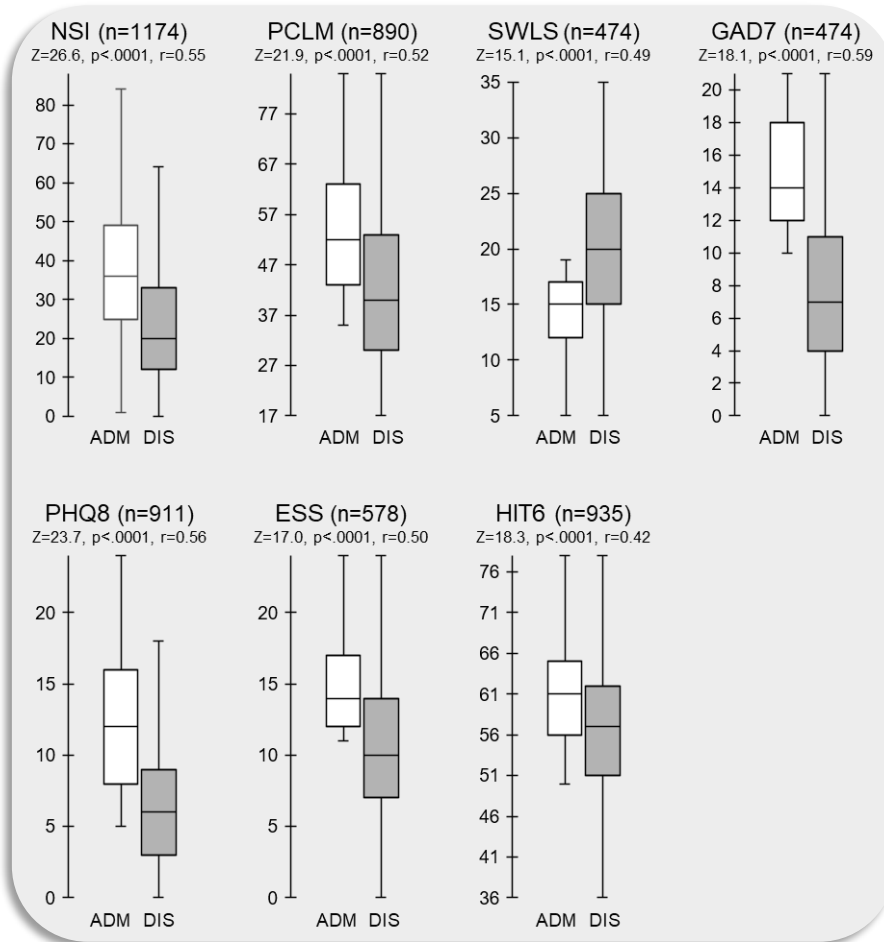


Patient Information



Admission and Discharge scores

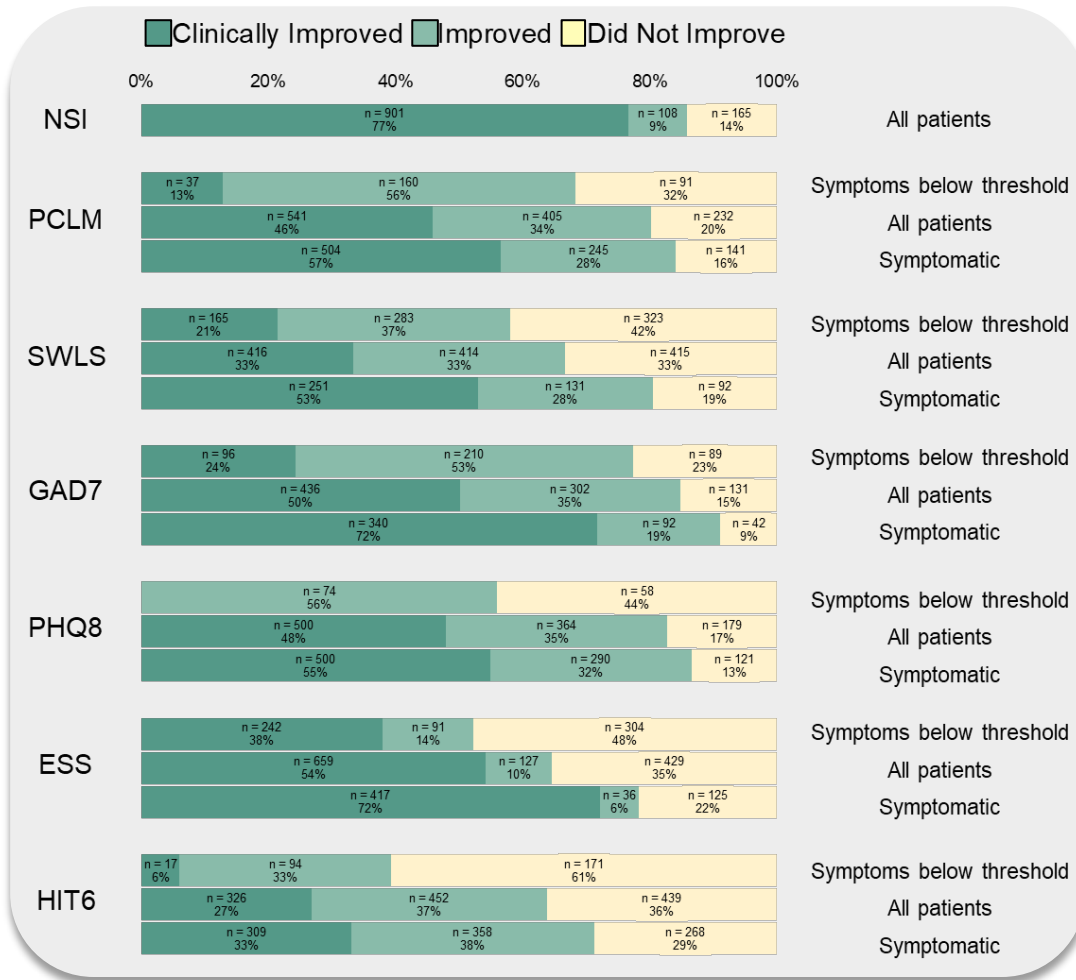
Scores significantly improved across all assessments



<u>Assessment</u>	<u>Symptomatic Range</u>
NSI	No composite threshold
PCL-M	≥35
SWLS	≤19
PHQ-8	≥5
GAD-7	≥10
ESS	>10
HIT-6	≥50

Improvement Percentages

The majority of patients improved or clinically improved across all assessments



<u>Assessment</u>	<u>Clinical Improvement Threshold</u>
NSI	≥5 point change
PCL-M	≥10 point change
SWLS	≥5 point change
PHQ-8	≥5 point change
GAD-7	≥5 point change
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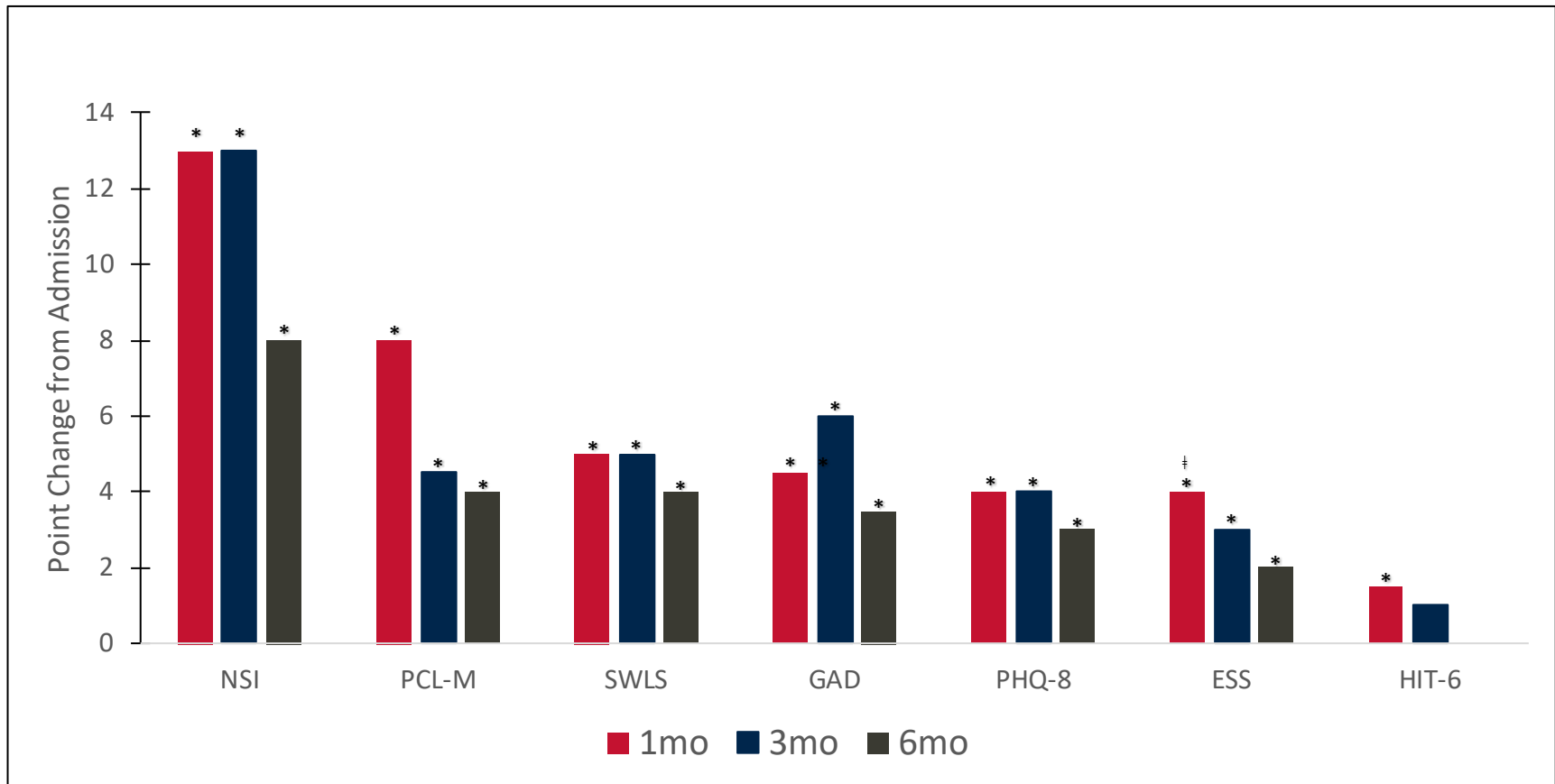
Comparison of TBI Quartiles

Improvement by patients who had the least and highest number of TBIs were not significantly different for all of the assessments except the NSI

Assessment	Quartile	N	Median ADM Score	Mean ADM Score	Median Δ	Mean Δ	U	Z	p
NSI	Quartile 1 (≤ 3)	335	40	40.92	11	12.47	40,672.0	-0.301	0.005*
	Quartile 4 (≥ 9)	280	34	35.98	15	15.46			
PCL-M	Quartile 1 (≤ 3)	292	55	56.42	11	11.49	33,924.5	-0.793	0.428
	Quartile 4 (≥ 8)	242	49	51.86	11	12.24			
SWLS	Quartile 1 (≤ 3)	169	14	13.51	5	5.60	9,675.0	-0.063	0.950
	Quartile 4 (≥ 8)	115	15	14.34	5	5.46			
GAD-7	Quartile 1 (≤ 4)	143	14	14.83	7	7.21	7,684.0	-0.440	0.663
	Quartile 4 (≥ 10)	111	14	14.43	7	7.04			
PHQ-8	Quartile 1 (≤ 3)	229	13	13.59	5	5.07	25,247.5	-0.530	0.596
	Quartile 4 (≥ 9)	227	11	11.56	5	5.47			
ESS	Quartile 1 (≤ 3)	175	14	14.79	4	3.26	10,379.0	-2.43	0.015
	Quartile 4 (≥ 9)	141	15	15.08	4	4.67			
HIT-6	Quartile 1 (≤ 3)	291	63	63.15	4	4.73	36,406.0	-0.301	0.764
	Quartile 4 (≥ 8)	254	60	59.72	4	4.58			

Change in median scores from Admission

Wilcoxon sign-rank test of assessment scores from Admission vs. 1-, 3-, & 6 month time points, show that patients continue to have a significant decrease of symptoms across most measures



* $p < .001$; [‡]Large effect size

Potential Bias

No differences were seen in the follow-up rates of patients who clinically improved following treatment versus patients who did not experience a clinically significant improvement at discharge

Assessment	Discharge	1 Months	3 Months	6 Months
NSI	Clinically improved n=901	16% n=143	12% n=112	10% n=93
	Did not clinically improve n=273	14% n=38	8% n=23	12% n=32
		<i>p</i> =.47	<i>p</i> =.09	<i>p</i> =.53
PCL-M	Clinically improved n=504	15% n=75	8% n=40	11% n=54
	Did not clinically improve n=386	15% n=58	11% n=42	7% n=28
		<i>p</i> =.96	<i>p</i> =.15	<i>p</i> =.09
SWLS	Clinically improved n=251	15% n=38	12% n=29	8% n=20
	Did not clinically improve n=223	15% n=33	8% n=17	9% n=20
		<i>p</i> =.92	<i>p</i> =.17	<i>p</i> =.71
GAD-7	Clinically Improved n=340	19% n=64	14% n=48	11% n=39
	Did not clinically improve n=134	18% n=24	12% n=16	13% n=17
		<i>p</i> =.84	<i>p</i> =.56	<i>p</i> =.73

Assessment	Discharge	1 Months	3 Months	6 Months
PHQ-8	Clinically Improved n=500	16% n=80	12% n=60	11% n=56
	Did not clinically improve n=411	15% n=62	12% n=51	9% n=39
		<i>p</i> =.73	<i>p</i> =.86	<i>p</i> =.43
ESS	Clinically Improved n=417	13% n=54	12% n=50	11% n=46
	Did not clinically improve n=161	14% n=22	11% n=17	11% n=18
		<i>p</i> =.83	<i>p</i> =.65	<i>p</i> =.96
HIT-6	Clinically Improved n=309	10% n=30	9% n=28	11% n=34
	Did not clinically improve n=626	12% n=78	11% n=67	9% n=55
		<i>p</i> =.24	<i>p</i> =.46	<i>p</i> =.30
Average Follow-up Rate Per Time Point:		15%	11%	10%

P-values reflect chi-square tests. Bonferroni Correction $p = .01$



NATIONAL INTREPID CENTER OF EXCELLENCE
WALTER REED BETHESDA

Differences in Scores Between Enlisted and Officers

Change from ADM vs 1-, 3-, and 6 month time periods were compared between enlisted & officers. No significant differences were seen between the two groups with the exception of the PCL-M at the 1 month time point.

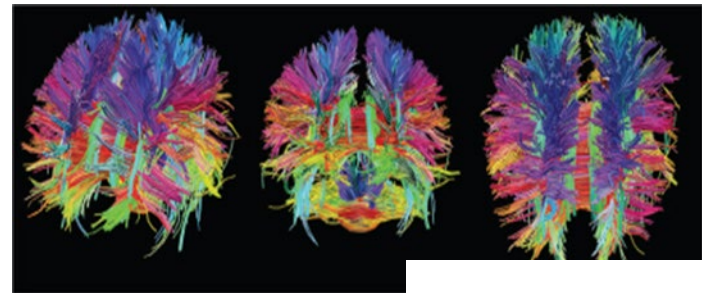
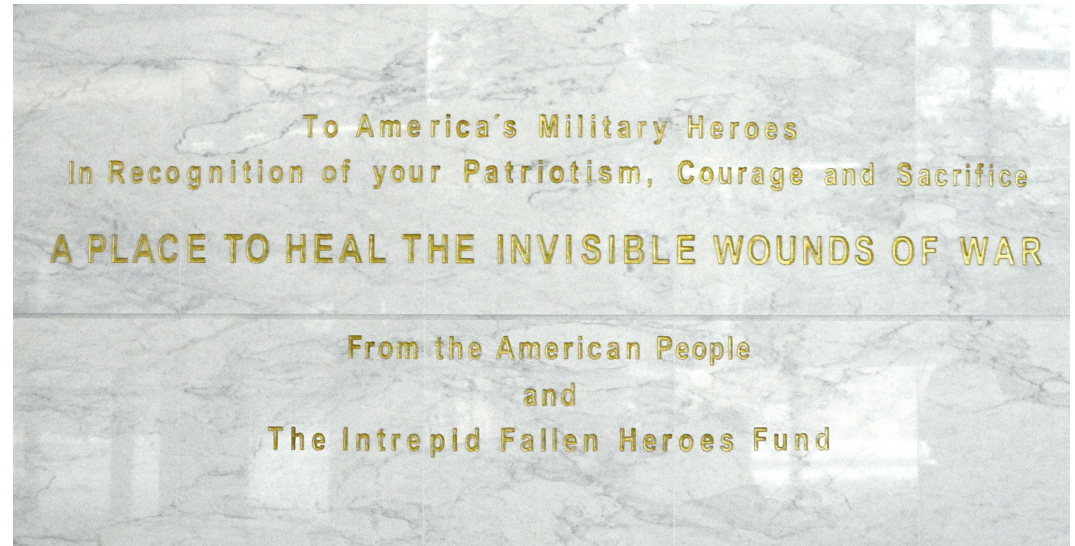
Assessment	Time Point	Rank	N	Median ADM Score	Mean ADM Score	Median	Mean (SD)	U	Z	p
NSI	1 Month	Enlisted	134	23	26.47 (15.69)	7.5	8.52 (11.23)	2,400.5	-1.85	0.065
		Officer	44	19	23.66 (19.10)	12.0	12.84 (13.99)			
	3 Month	Enlisted	94	23	25.40 (16.78)	8.5	7.77 (11.72)	1,398.0	-1.95	0.051
		Officer	38	19.5	21.66 (16.57)	11.5	12.76 (15.06)			
	6 Month	Enlisted	89	26	27.43 (16.70)	7.0	5.65 (13.56)	1,482.0	-0.175	0.861
		Officer	34	23.5	27.85 (20.16)	6.5	6.71 (14.14)			
PCL-M	1 Month	Enlisted	100	46	45.11 (14.88)	7.0	6.62 (11.96)	974.5	-2.905	0.004*
		Officer	30	39	40.63 (16.47)	15.0	14.87 (14.28)			
	3 Month	Enlisted	53	45	48.51 (15.89)	2.0	2.32 (13.05)	508.5	-1.884	0.060
		Officer	26	37.5	40.65 (15.66)	9.5	9.12 (16.73)			
	6 Month	Enlisted	58	46	46.97 (15.52)	3.0	4.74 (14.15)	573.0	-0.701	0.483
		Officer	22	46.5	45.14 (18.05)	5.0	5.77 (14.56)			

Enlisted: E-3,4,5,6,7,8,9; Officer: W-1,2,3,4,5; O-1,2,3,4,5,6

Study Limitations

- No control group
- Limited percentage of follow up

Predictors of Trajectory



Photos Courtesy NICoE PAO

Role of Sleep on Suicidal Ideation in Service Members

Sleep variables as related to suicidal question on the PHQ-9: “thoughts that you would be better off dead or of hurting yourself in some way”

Variable	N	Odds Ratio	95% CI
Pittsburgh Sleep Quality Index**	489	1.17	1.06—1.29
Epworth Sleepiness Scale*	1,188	1.05	1.01—1.09
Bad Dreams	1,193		
<1 per week		1.98	0.93—4.21
1-2 per week***		4.39	2.23—8.65
3+ per week***		7.89	4.04—15.40
Traumatic Bad Dreams	1,170		
A little bit		1.49	0.76—2.95
Moderately***		4.20	2.19—8.04
Quite a bit***		5.04	2.62—9.67
Extremely***		9.90	4.71—20.83

Frequent bad—or traumatic bad—dreaming predicts suicidal ideation in active-duty Service members

* p < .05; ** p < .01; *** p < .001

Role of Art Therapy Visual Imagery in PH Outcomes in Service Members

- Participants
 - Active-duty Service members (n=370) with a history of TBI, PTSD, PH conditions
- Setting
 - National Intrepid Center of Excellence (WRNMMC)
- Design
 - Observational study of correlations between visual themes in mask imagery and clinical symptoms of PTSD, depression, anxiety
 - Masks
- Primary outcomes
 - PTSD Checklist—Military
 - Patient Health Questionnaire-9
 - Generalized Anxiety Disorder-7

Observed Mask-making Themes

Patriotism



The Injury



Death/Grief



Role of Visual Imagery in PH Outcomes in Service Members (cont.)

Mask Depictions	PTSD	Depression	Anxiety
Psychological injury ^A	↑	↑	
Military unit identity ^B	↓	↓	↓
Military symbols ^C	↑	↑	↑
Metaphors (subtypes)			
Colour symbolism	↑	↑	↑
Cultural / historical characters	↓	↓	↓
Sociocultural symbols	↓	↓	↓
Nature	↓	↓	↓

↓ Symptoms decreased (improved)
 ↑ Symptoms increased (worsened)

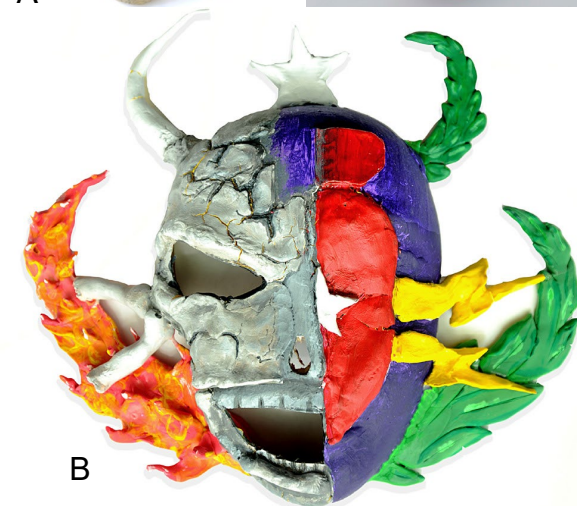
Psychological injury
Use of fragmented military symbols



A



C



B

Identification with military unit

Emergent patterns of resilience and risk embedded in the use of images created by the participants could provide valuable information for patients, clinicians, and caregivers

Future Direction

- Hierarchical Cluster Analysis to identify key factors in recovery trajectory.
- Standardize recording of assessments, treatments and outcomes metrics in the Network
- Identify disease mechanisms for objective outcomes
- Validate response trajectory in spectrum of traumatic brain injuries (time and severity)
- Engage in retrospective and prospective research to rapidly advance clinical practice and management guidelines

[Special Project: TRIP Initiative]

Defense Intrepid Network



ISC JB Lewis-McChord



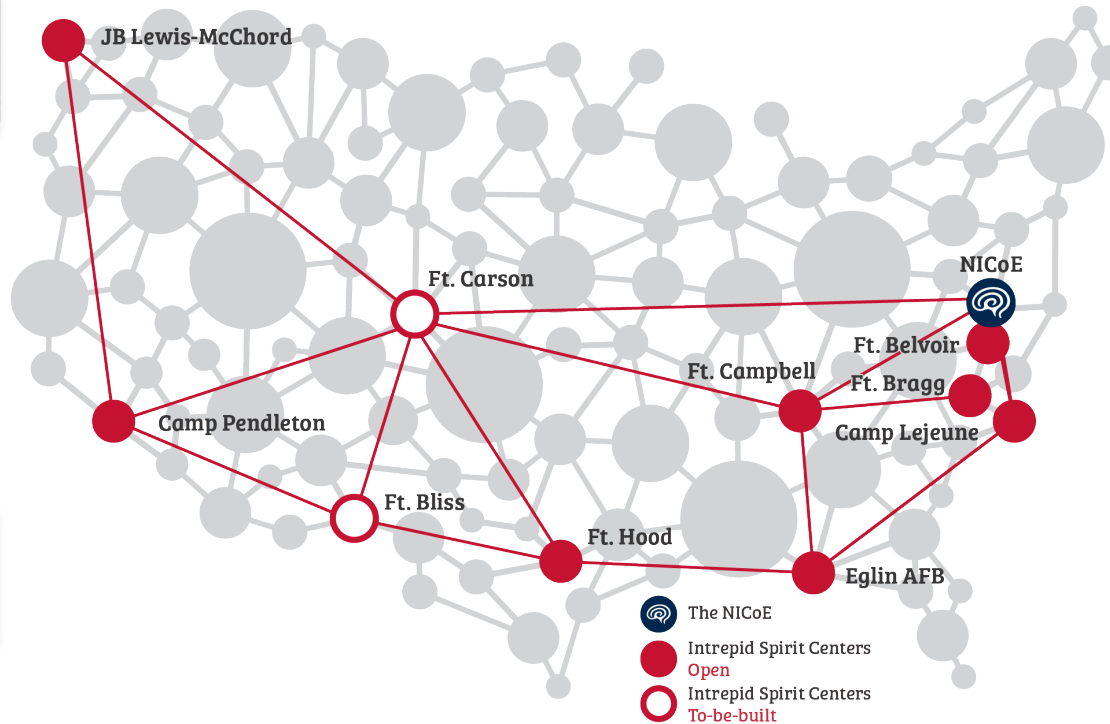
ISC Camp Pendleton



ISC Fort Hood



ISC Fort Campbell



ISC Fort Carson (FUTURE)

ISC Fort Bliss (FUTURE)



ISC Eglin



NICoE



ISC Fort Belvoir



ISC Camp Lejeune



ISC Fort Bragg

Summary

- Establishment of clinical research center for TBI and Brain Health provides a **standardized clinical platform for individualized care**.
- Systematic collection of data allows for **increased precision symptom characterization**
- The NICoE **Interdisciplinary Intensive Outpatient Program** produces measurable and sustainable outcome improvements in Service members
- Changes in **multiple domains** are both statistically significant and clinically meaningful
- Collection of granular longitudinal data in a large military population can be used to determine **predictive factors for risk and improvement** and/or return to duty.
- **Defense Intrepid Network** demonstrates applicability of the care model

Service Member's Work in Healing Arts



*You allowed me to open up to you
and communicate a burden I have
carried for so long... here is one
more haiku:*

*Bitter no more
Dream of hope, freedom at last
Change is forever*

Courtesy NICoE Art Therapy

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Walter Reed
National Military
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Discussion



Photo Courtesy of NICoE