

# LIMBIC-CENC PROSPECTIVE LONGITUDINAL STUDY (PLS)

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# BLUF

- **Current Status of Aim 1** : *Recruit and serially assess cohort*
  - Enrollments restarted in face of COVID pandemic
  - Continued excellence in hybrid longitudinal f/u assessments
- **Current Status of Aim 2**: *Scientific analyses that will impact clinical care*
  - Early scientific analysis with n>1,550 well underway
  - Key Findings to date:
    - Biologic and other objective evidence of poorer outcomes with 3+ lifetime mTBIs
    - Comorbidities, usually modifiable ones, heavily contribute to outcomes regardless of number of lifetime mTBIs
  - Multi-pronged dissemination efforts
- **1-year goal**: Complete highest priority cross-sectional analyses
- **End of Cycle Goals**: Suite of knowledge translation products



# Lifetime TBI Diagnoses in Cohort

(as of March 2020)

- Almost all (82%) at least one lifetime potential concussive events (PCE).
- Overall\*, a median (IQR) of 2 (1,3) PCEs per person.

\*not counting most controlled blast exposures

mTBI Exposures (Median [IQR])					
	Entire Cohort (N=1563)	Study Groups			
		Combat Plus (N=596)	Combat Only (N=271)	NonCombat (N=407)	No TBI* (N=289)
Age at First Mtbi	19[12,24]	17[11,21]	25[21,32]	16[10,22]	N/A
Years Since Last Mtbi	10[6,15]	9[5,11]	10[6,13]	15[8,25]	N/A
Total mTBIs	2[1,3]	3[2,4]	1[1,2]	1[1,2]	N/A
By Type					N/A
Blast	0[0,1]	1[0,1]	1[0,1]	0[0,0]	N/A
Non-Blast	1[0,2]	2[2,4]	0[0,1]	1[1,2]	N/A
With PTA	1[0,2]	2[1,3]	1[0,1]	1[0,1]	N/A
No PTA	1[0,2]	2[1,3]	1[0,1]	1[0,1]	N/A

## mTBI Subtypes: Combat, Blast, and Repetitive (3 or more)

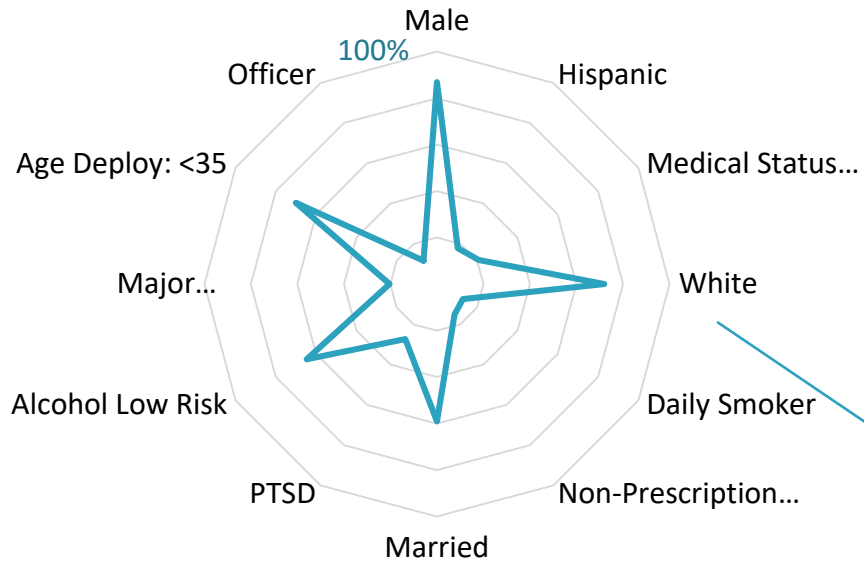
Combat, Blast, Repetitive (N=329)			Combat, Blast (N=256)		Combat (N=151)		1-2 mTBIs, Subtype Negative (N=316)	No TBI (N=289)
3 Exposure Subtype			2 Exposure Subtype		1 Exposure Subtype			
			Combat, Repetitive (N=130)	Repetitive, Blast (N=4)	Repetitive (N=80)	Blast (N=8)		



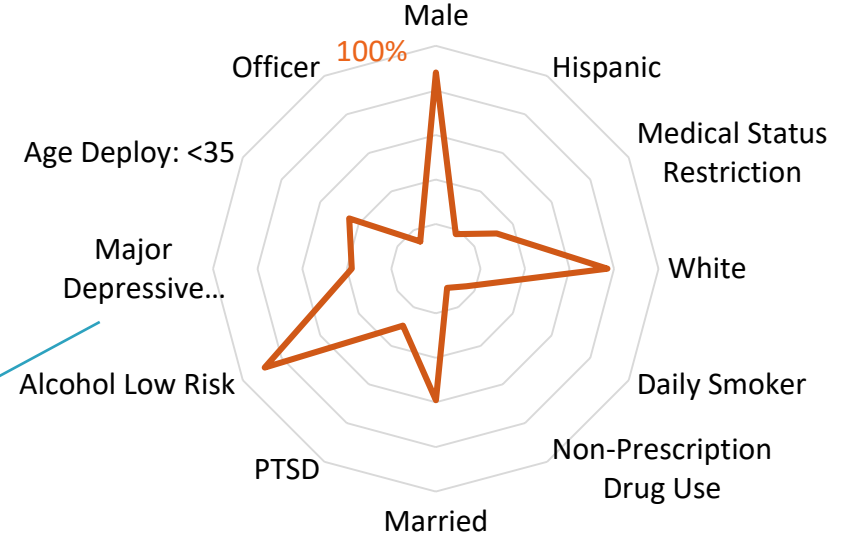
# Comparison of Accrued Study Cohort to OEF/OIF Population

— LIMBIC-CENC      — General OEF/OIF/FO Population (average of all sources)

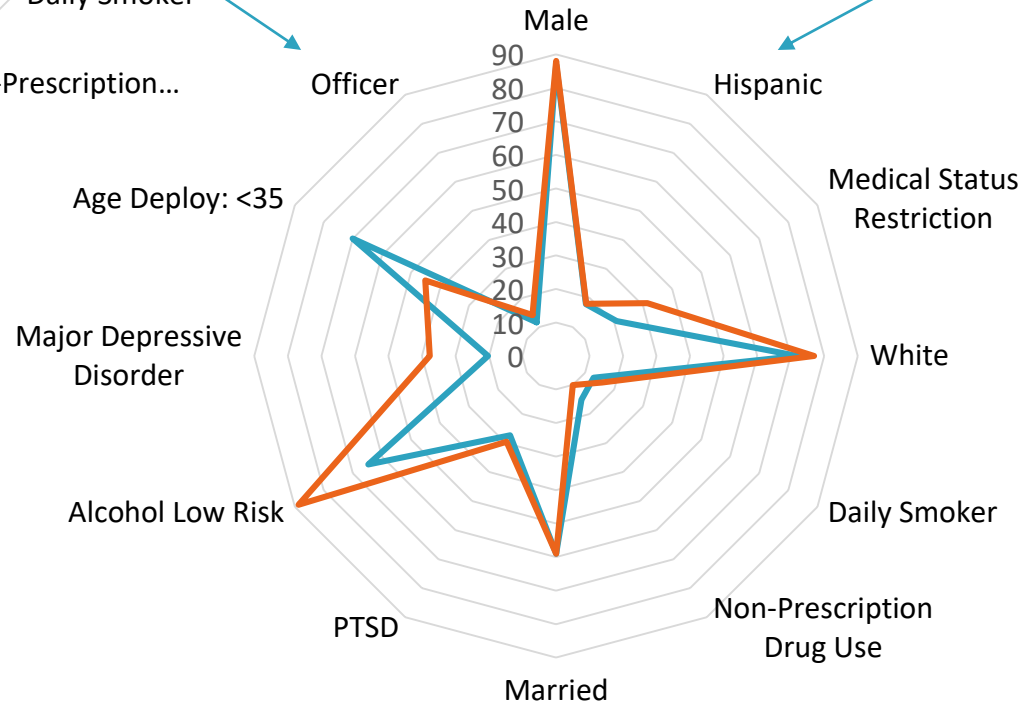
**LIMBIC cohort is highly representative of the overall OEF/OIF cohort that we have been tasked to study**



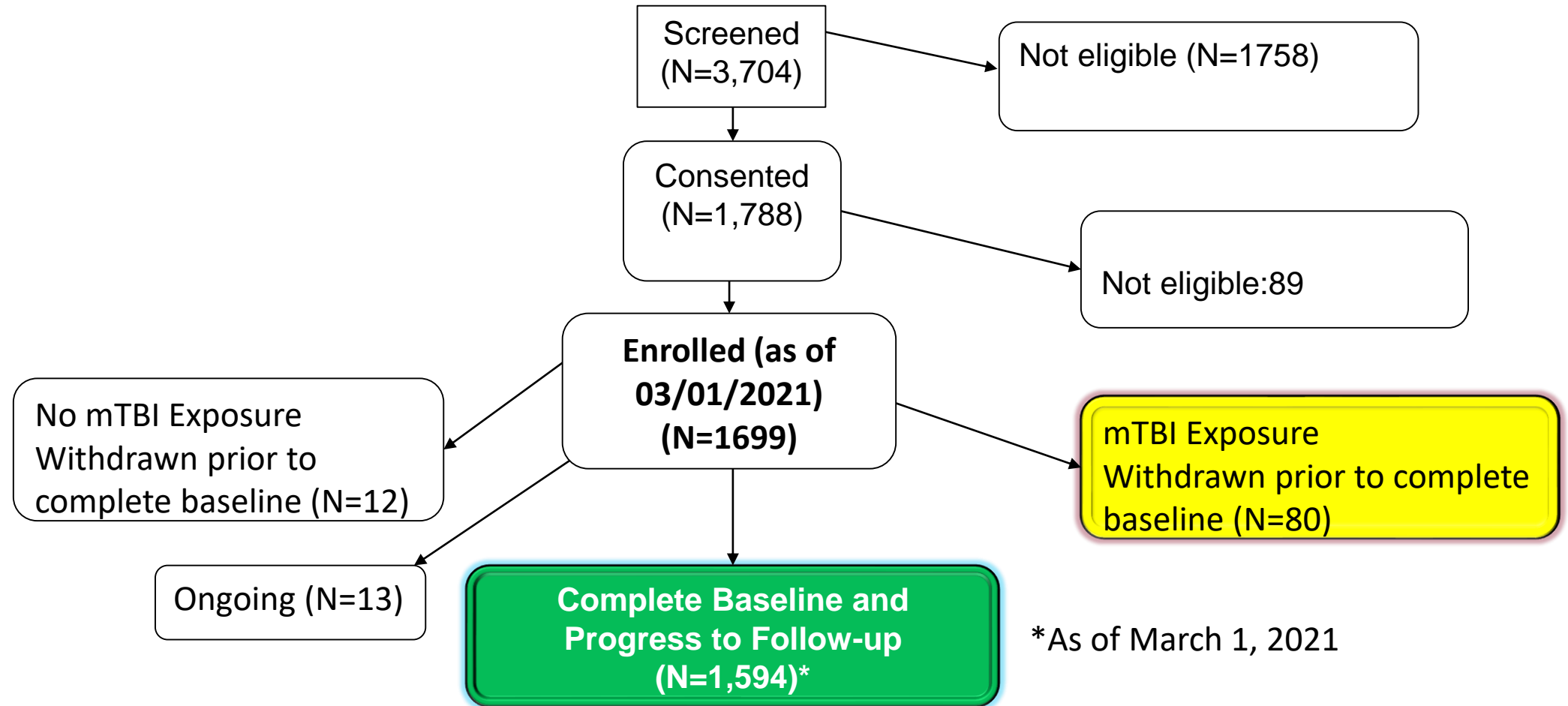
**LIMBIC-CENC Cohort**



**General OEF/OIF Cohort**



# Study Consort Diagram for Initial Evaluations



- Proportion with mTBI(s): 81.5%
- Median (IQR) # mTBIs per person: 2 (1,3).

# Regulatory Update

- Local IRB Approval
  - All PLS sites have gained initial local IRB approval for the new LIMBIC-CENC PLS protocol
  - All PLS sites have maintained their active approval status under continuing review processes
- HRPO Approval
  - All PLS sites have gained initial HRPO approval
  - All PLS sites have maintained their active approval status under continuing review processes.
- COVID-19 site clearance for in-person (face-to-face) research activities
  - Nine sites have returned to in-person research activities to some degree
  - Only Boston and San Diego still suspended from in-person b/c local Covid-19 surge/restrictions
- Enhanced regulatory tracking system under development



# Response to COVID-19 Impact on Longitudinal Visits

- Enhanced remote data collection for comprehensive follow-up visits
  - Questionnaires, interviews, auditory cognitive tests by phone/mail
  - Launched new web-based data entry/capture system option for questionnaires
  - Seeking regulatory approvals for video-enabled cognitive testing and DocuSign of revised consent forms
- New COVID questionnaire added to annual phone visits
- COVID safety procedures enacted for in-person visits at permitted sites



# Sub-Task: Retention & Longitudinal Assessments

Volume of follow-up (longitudinal) visit assessments completed (through Feb 28, 2021)

	Comprehensive	BTACT only	Annual Brief
Last 6 months (Q3-Q4 2020)	124	86	414
During LIMBIC (since Oct 01, 2019)	319	245	1053
Since CENC inception	742	561	2399

Despite COVID-19 challenges, maintained:

- High retention rate: Currently 89%
- Excellent overall follow-up visits completion rates:
  - 76% for Comprehensive
  - 67% for Brief





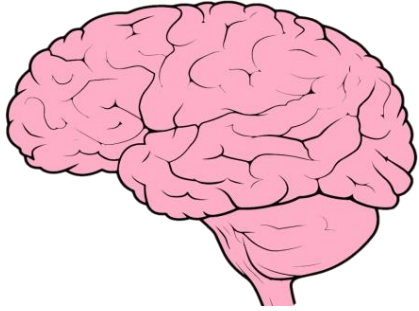
# Highlights of Dissemination

- In general, analyses from CENC Snapshot dataset #1 indicated that 1-2 prior mTBIs is a risk factor for symptom burden but not for objective neurologic findings (neurocognitive testing, imaging, neurosensory testing).
- Early analyses suggest that 3 or more mTBIs may have objective late neurologic effects (lower postural stability, neurodegeneration byproducts in blood).
- A new publication (Werner et al, *Sleep*) was highlighted in a recent edition of Neurology Advisor (<https://www.neurologyadvisor.com/topics/traumatic-brain-injury/sleep-quality-and-cognitive-function-in-patients-with-mild-traumatic-brain-injury/>).
- Knowledge Translation Center (KTC) products expanding

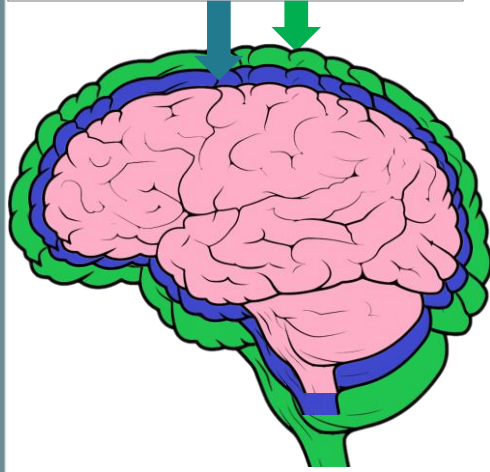


## Healthy Brain

Maximum Deployed Brain Function

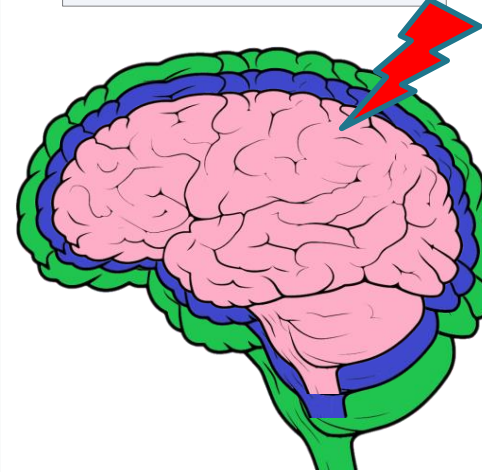


Reserve Brain Function

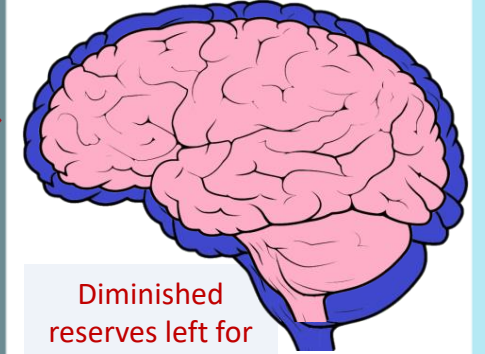


## Concussed Brain

1<sup>st</sup> Concussion



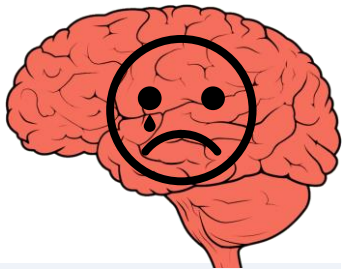
After 1<sup>st</sup> recovery



Variable Time

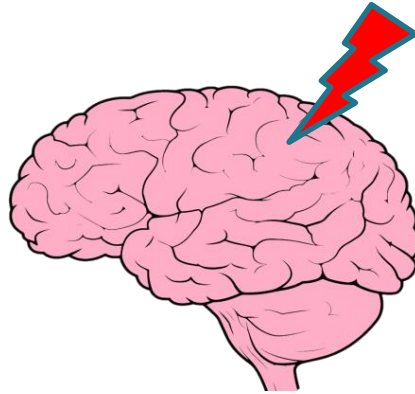


3<sup>rd</sup> Recovery Fails



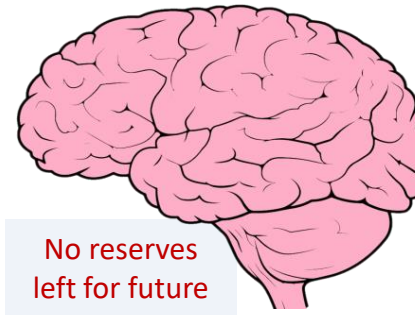
3<sup>rd</sup> recovery is incomplete because no reserves were available for full repair

3<sup>rd</sup> Concussion



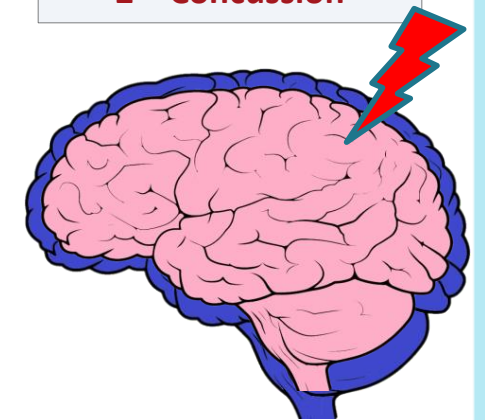
Variable Time

After 2<sup>nd</sup> Recovery



No reserves left for future repair

2<sup>nd</sup> Concussion



# Addressing the Challenge of Accurate Lifetime mTBI Diagnoses

- Screening for all lifetime potential concussion events (PCEs) based on OSU TBI-ID
- Validated structured interview for each PCE that generates an algorithm diagnosis
  - VCU retrospective Concussion Diagnostic Interview (VCU rCDI)
  - Walker WC, et al. J Neurotrauma 2015;32(7):464-73.
- Open ended interview component to cross check structured interview along with any early/subacute documentation
- If doubt exists, additional unstructured interview may occur, then Site PI either:
  - confirms algorithm, or
  - overrides algorithm, or
  - refers to central diagnosis committee
- Central review and QA processes



# Immediate Impact on Clinical Care of Participants

- Clinically relevant incidental finding notification and referrals.
- This most recent quarter:
  - **2** participants have been notified of potentially clinically actionable abnormal results
  - **4** incidental findings were addressed through clinical referral or communication by study personnel
- Cumulative since starting log in late 2016:
  - **243** participants have been notified of potentially clinically actionable abnormal results
  - **101** incidental findings have been addressed through clinical referral or communication by study personnel

PLS

Site submission

FortGordon  
SanDiego  
Salisbury  
Boston  
Minneapolis  
Portland  
FortBelvoir  
SanAntonio  
Tampa  
Houston  
Richmond

0 1

# Participants total

243

	1/2021	2/2021	3/2021	Quarter total	Study total
Abnormal finding	0	4	2	6	270
Participant notification	0	1	1	2	253
Clinical action/referral	0	2	2	4	101

Quarter

Q1/2021

Site

Site	# Participants total	Q1/2021	1/2021	2/2021	3/2021	Quarter total	Site total	(2015-2018)
Richmond	35	Abnormal finding	0	0	0	0	37	37
		Participant notification	0	0	0	0	37	37
		Clinical action/referral	0	0	0	0	9	9
Houston	56	Abnormal finding	0	0	0	0	68	68
		Participant notification	0	0	0	0	64	64
		Clinical action/referral	0	0	0	0	7	7
Tampa	27	Abnormal finding	0	0	0	0	34	34
		Participant notification	0	0	0	0	34	34
		Clinical action/referral	0	0	0	0	5	5
SanAntonio	44	Abnormal finding	0	0	0	0	46	46
		Participant notification	0	0	0	0	46	46
		Clinical action/referral	0	0	0	0	46	46
FortBelvoir	0	Abnormal finding	0	0	0	0	0	0
		Participant notification	0	0	0	0	0	0
		Clinical action/referral	0	0	0	0	0	0
Portland	42	Abnormal finding	0	2	2	4	44	40
		Participant notification	0	1	1	2	38	36
		Clinical action/referral	0	2	2	4	24	20
Minneapolis	13	Abnormal finding	0	2	0	2	13	11
		Participant notification	0	0	0	0	11	11
		Clinical action/referral	0	0	0	0	10	10
Boston	26	Abnormal finding	0	0	0	0	28	28
		Participant notification	0	0	0	0	23	23
		Clinical action/referral	0	0	0	0	0	0



# Treatable Comorbidities Impacting Key Outcomes

- Sleep apnea
- Pain
- PTSD
- Depression
- Others under investigation as well as lifestyle factors



# Summary for Aim 1 : *Cohort and Assessments*

- Status:
  - Emerging from COVID delay in enrollment rates
  - Extensive mitigation strategies have been deployed w/r pandemic
  - Robust retention and longitudinal visit completion rates
- Key Risk:
  - Lingering fear/avoidance of in-person in target population and stay-at-home mindset
- Key Deliverables:
  - Up-to date FITBIR data publishing
  - External collaborations developed



# Summary for Aim 2 : *Data Analyses and Disseminate Knowledge*

- Status:
  - Ramping up cross-sectional analyses for  $n > 1550$  datasets
  - Razor sharp focus on KT products for all stake-holders including SMs and Vs
  - Already producing actionable clinical care and clinical research
- Key Risk:
  - lower power if unable to catch-up COVID delays in enrollments and some longitudinal measures (e.g., blood draws)
- Key Deliverables:
  - Knowledge on impact of repetitive mTBIs as well as comorbidities
  - KT product suite



# Summary

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    - Comorbidities, usually modifiable ones, heavily contribute to outcomes regardless of number of lifetime mTBIs
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- **Key 1-year goal**: Complete highest priority cross-sectional analyses
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# QUESTIONS



# BACK-UP SLIDES

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Study Assessments synopsis and flow

Longitudinal Timeline with index event/date examples

Longitudinal Consort Diagram

Clinical Care Notifications



# Specific Aims of LIMBIC-CENC Multicenter PLS

- Enroll and assess 3,000 combat-exposed SM/Vs predominantly with mTBI(s)
  - Targeted expansion of pre-911 era SM, current SMs, heavily blast exposed
  - Collect initial and longitudinal data under TBI CDE guidelines and submit to the FITBIR
- Investigate mTBI co-morbidities and neurologic outcomes including change over time
- Identify potential differences between mTBI groups
  - Negative vs. single vs. multiple TBI history in outcomes
  - individuals with and without historical exposure to repetitive low-level blast
  - deployment-related vs. nondeployment-related mTBI.
- Identify pathophysiological and biomarker signatures for chronic mTBI subgroups of recovery patterns and neurodegeneration susceptibility
- Evaluate neuroimaging techniques to understand the relationships between mTBI and neurodegenerative disease and other co-morbidities.

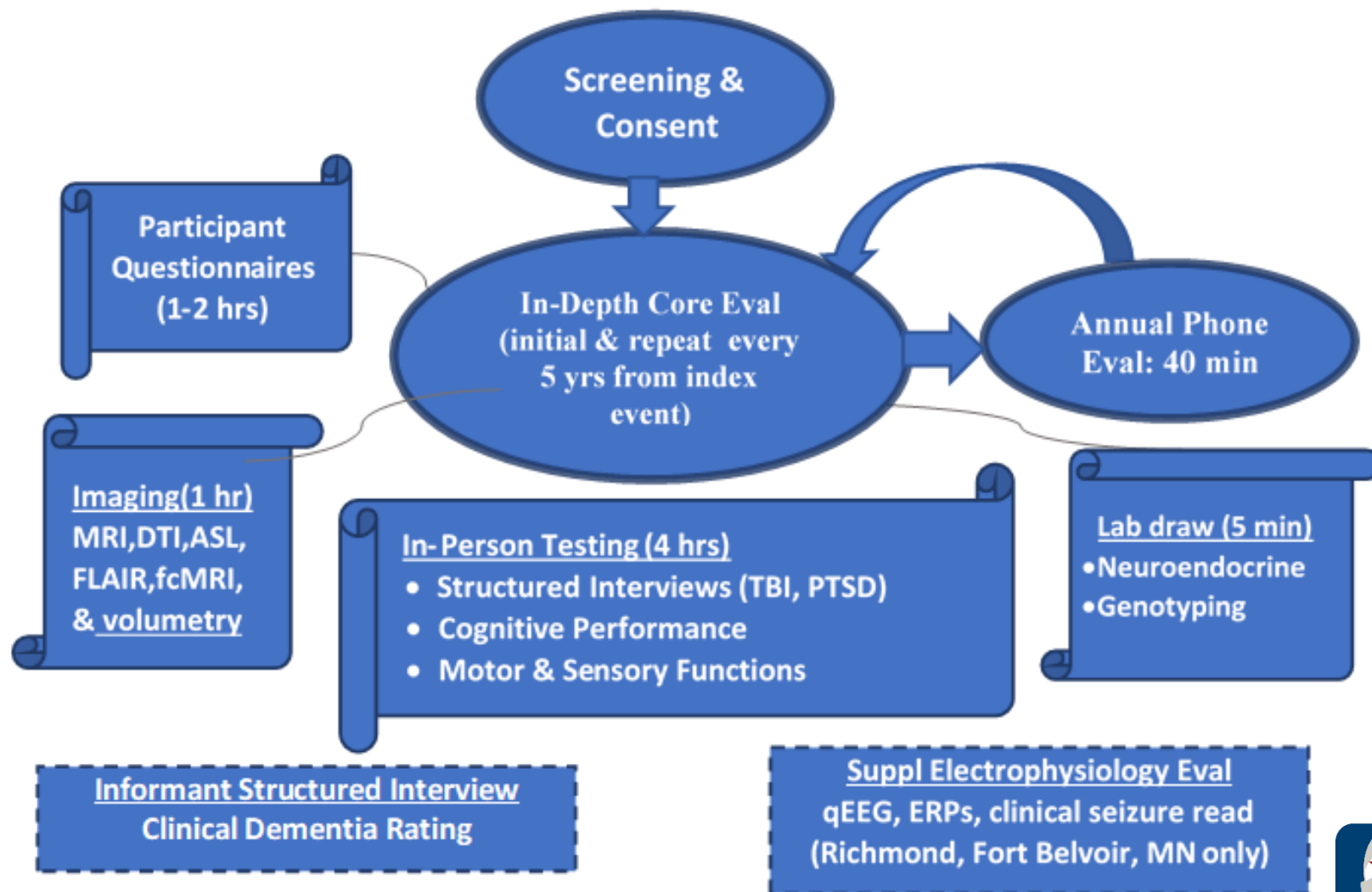


# Methods Synopsis

- Comprehensive, holistic, 360 degree assessment of brain and neurologic health and functioning
- Prospective follow-up (longitudinal) evaluations
  - Annual brief (< 1 hr) telephonic
  - Comprehensive full-day at least once every 5 years
  - Merging of retrospective (administrative) data
- Scientific analyses
  - LIMBIC internal analyses of prospective data, longitudinal and cross-sectional
  - Collaborations with other scientific stakeholders
  - Sharing of datasets directly from external requests and through the FITBIR
- Leveraging cohort for
  - Dual study enrollment
  - Additional funding opportunities with added research aims



# Study Evaluation Flow Diagram



# Regulatory Tracking System Development

- The coordinating Center is working with the DBC to create an electronic system to track regulatory submissions. This system will track the following items for all PLS sites and cores:
  - Local IRB continuing review approval and expiration date
  - HRPO continuing review approval and expiration date
  - Regulatory approval documents including approval letter and all the approved documents such as ICF, HIPAA and protocol
  - PLS amendment submissions including submission and approval date
- The system also sends an automated reminders to the sites/cores 60 days prior to the continuing review expiration date
- This system also serves as a repository for all PLS regulatory documents
- Users with LIMBIC-CENC website access will be able to review the regulatory tracker once implemented



# Sample Timeline; Index Event 7 Years Before Initial Enrollment Visit

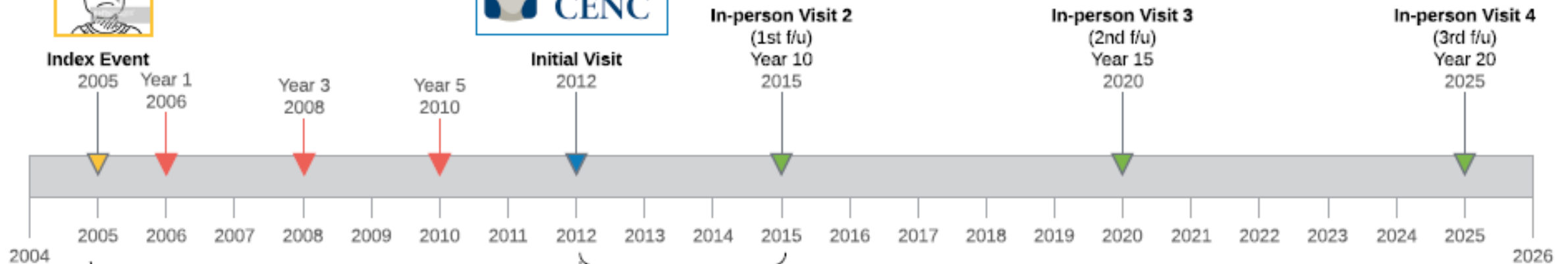
**Index Event & Date:**  
F/u visits are timed to the Index Event.  
Index Event = Worst mTBI during a  
combat deployment.\* The Index Date=  
date of that Index Event.



**Initial Visit Date:**  
Date participant completes  
initial (Baseline) study visit



After First Longitudinal In-Person Follow-up Visit, the remainder of  
In-Person Follow-up visits reoccur every 5 years in perpetuity. \*\*

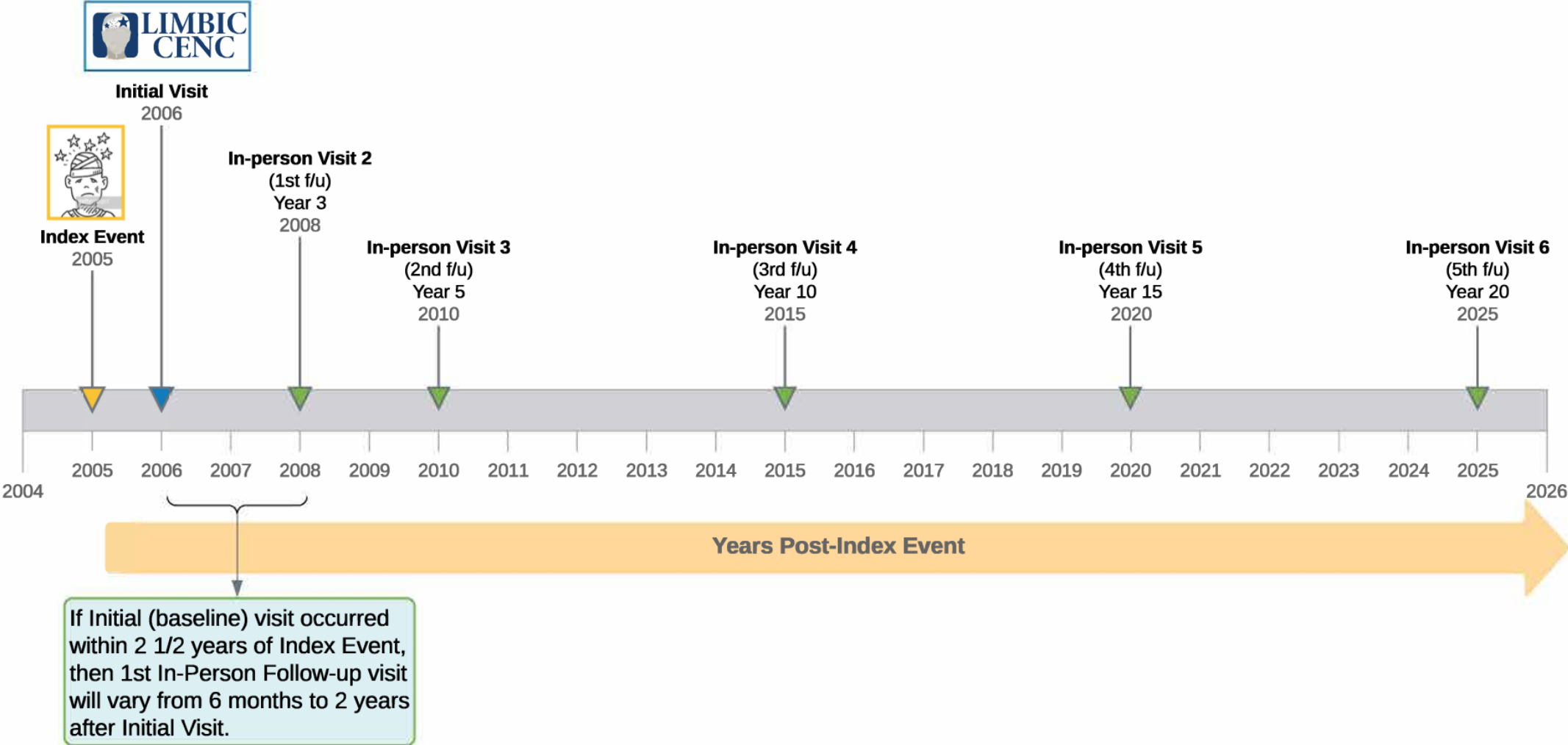


The time between Index Event and Initial Visit depends on how long before initial visit the index event took place.

The time between Initial Visit and 1st in-person f/u varies from 1 to 5 years



# Sample Timeline 2; Initial Visit 1 Year Post Index Injury





# Sample Timeline 3; No Injury

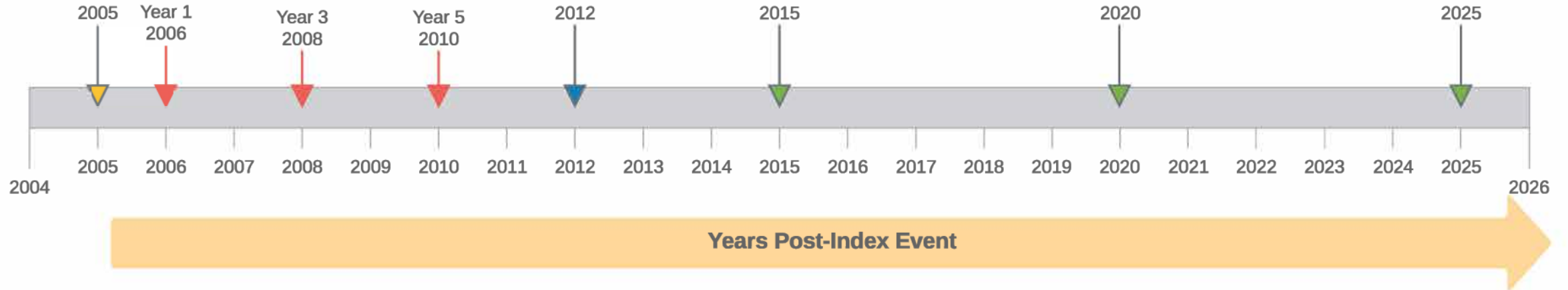
## Index Event & Date:

### **No mTBI present**

If none (e.g. TBI negative controls), traumatic event during deployment despite not being a clinical TBI.



## Index Event



# Study Consort Diagram for Longitudinal Evaluations

**Subject Level:**  
As of 02/28/2021  
Follow-up Evaluation Completion Rates  
(Window Closed):  
In-Person and Annual Phone

- (N= 114 Subjects 1 F/u due)
  - Visit completed: 58
  - Visit missed: 56
- (N= 464 Subjects 2 F/u due)
  - One visit completed: 112
  - Both visits Complete: 256
  - One Visit missed: 113
  - Both visits missed: 95
- (N= 464 Subjects 3 F/u due)
  - Three completed visits: 216
  - Two completed visits: 122
  - One visit completed: 75
  - All visits missed: 51
- (N= 338 Subjects 4 F/u due)
  - Four completed visits: 137 65
  - Three completed visits: 72 15
  - Two completed visits: 57 18
  - One completed visits: 39
  - All visits missed: 33
- (N= 150 Subjects 5 F/u due)
  - Five completed visits: 64
  - Four completed visits: 32
  - Three completed visits: 21
  - Two completed visits: 17
  - One completed visits: 12
  - \*Any Missed Visits: 86
- (N=4 Subjects 6 F/u due) Six visits completed: 1

**Baseline Graduates  
(N=1,594)**

**Exited Study (N= 171)**

**Visit Level:**  
Untill Feb 2021

In-Person Follow-up: 982  
Completed: 742 (76%)  
Missed: 240 (24%)

Annual Phone Assess: 3579  
Completed: 2399 (67%)  
Missed: 1179 (33%)

**89% of the  
Baseline Graduates  
are still in the study**



# Post-mTBI pain interference in a U.S. military population: A CENC Study

- Journal/Authors:
  - Mil Med. 2020 Oct 3. Online ahead of print
  - Khokhar, B. R., Lindberg, M. A., & Walker, W. C.
- Question: Among SMs & combat Vs with mTBI, how common is pain interference (functional limitations from chronic pain) and what are the potential risk factors?
- Findings: > 76% had Moderate to High pain interference. Risk factors were PTSD, anxiety, depression, and > 3 lifetime mTBIs.
- Meaning: These findings highlight the complexity and overlap of comorbid symptoms. SMs & Vs with lingering effects of mTBI may require a more comprehensive and holistic approach during treatment.



# Obstructive sleep apnea risk is associated with cognitive impairment after controlling for mTBI: A CENC Study

- Journal/Authors:
  - J Neurotrauma 2020 Dec 1;37(23):2517-2527.
  - Garcia, A; Reljic, T; Pogoda, TK; Kenney, K; Agyemang, A; et al.
- Question: How common is OSA in combat exposed SM & Vs with mTBI and what is it's relation to cognition?
- Findings: 64% of TBI positive and 50% of TBI negative were at risk for OSA. After adjusting for demographics and TBI history, those at OSA risk had poorer scores on trail-making B and WAIS-IV coding and reported greater cognitive difficulties.
- Meaning: Because OSA risk is associated with cognitive functioning, early identification and treatment of OSA may improve outcomes after mTBI.



# Potential concussive event narratives of Post-9/11 combat Veterans: A CENC Study

- **Journal/Authors:**
  - Mil Med. 2020 Oct 3. Online ahead of print
  - Yee J, Marchany K, Greenan MA, Walker WC, Pogoda TK
- **Question:** What are some of the ways that current and former Post-9/11 combat-deployed U.S. military Service Members experienced potential concussive events (PCEs)?
- **Findings:** Among Boston-site participants, 51% of worst deployment-incurred PCEs were blast-related. Qualitative analysis of semi-structured interview found these leading themes: driving over improvised explosive devices, being knocked off their feet and hitting their heads on another object or surface due to the physical force of the blast, and experiencing headache or disorientation even in the absence of physical impact to the head.
- **Meaning:** First-hand accounts of PCEs offer a richness in description and intensity not often captured in quantitatively-oriented head injury research. Capturing this qualitative data should lead to better understanding their relation to any acute and long-term effects.



# Associations among PTSD and Post-concussive symptoms in the LIMBIC-CENC Prospective, Longitudinal Study Cohort.

- Journal/Authors:
  - J Head Trauma Rehabil (In Press)
  - O'Neil ME, Klyce DW, Pogoda TK, Eggleston BE, Cameron DC, et al.
- Question: How do mTBI-related symptoms measured by the Neurobehavioral Symptom Inventory (NSI) correlate with mTBI history and PTSD status?
- Findings: NSI symptoms highly correlated with PTSD symptoms in both mTBI positive and negative. . Symptoms clustered similarly (somatosensory, affective, cognitive, and vestibular) regardless of mTBI or PTSD status.
- Meaning: NSI symptom clusters are broadly valid for future research and may serve as useful clinical constructs for evaluation and treatment.



# Does Mild Traumatic Brain Injury lead to Chronic Pituitary Disorders?

## A multicenter LIMBIC-CENC analysis

- **Journal/Authors:**
  - J Neurotrauma. Submitting to LIMBIC special edition
  - Walker WC, Kenney K, Agyemang AA, Allen CM, Werner JK, Troyanskaya M.
- **Question:** Are pituitary disorders a potential late effect of mild traumatic brain injury (mTBI)?
- **Findings:** Rates of markers of growth hormone deficiency (GHD), hypothyroidism, and male hypogonadism did not differ across any mTBI groups including TBI negative. Lab abnormalities also failed to meaningfully differentiate any of the hypothesized TBI-related clinical effects of these disorders (fatigue, depression, cognitive symptoms, or poorer executive function or processing speed).
- **Meaning:** These results do not support remote mTBI(s) is a risk factor these pituitary disorders. Clinicians should assess for these pituitary disorders based on other clinical factors.



# Biomarker Core

- Werner, J. K., Shahim, P., Pucci, J. U., Lai, C., Raiculescu, S., Gill, J. M., Nakase-Richardson, R., Diaz-Arrastia, R., & Kenney, K. **Poor sleep correlates with biomarkers of neurodegeneration in mild traumatic brain injury patients: a CENC Study.** *Sleep*. 2020 Dec 6;zsaa272. doi: 10.1093/sleep/zsaa272. Online ahead of print.
- Devoto C, Lai C, Qu BX, Guedes VA, Leete J, Wilde E, Walker WC, Diaz-Arrastia R, Kenney K, Gill J. **Exosomal MicroRNAs in Veterans with Mild Traumatic Brain Injury: Preliminary Results from a CENC Biomarker Discovery Project.** *J Neurotrauma* 2020;37(23):2482-2492. doi: 10.1089/neu.2019.6933. Epub 2020 Jul 2. PMID: 32458732.
- Guedes VA, Lai C, Devoto C, Edwards K, Qu BX, Rush H, Mithani S, Acott JD, Martin C, Wilde EA, Walker WC, Diaz-Arrastia R, Gill J, Kenney K. **Exosomal MiRNAs and Proteins are Linked to Chronic PTSD Symptoms in Servicemembers and Veterans with mild Traumatic Brain Injury.** Submitted to *Transl Psychiatry*.





# Imaging Core & Health Economics Study

- Bigler ED, Skiles M, Wade BSC, Abildskov TJ, Tustison NJ, Scheibel RS, Newsome MR, Mayer AR, Stone JR, Taylor BA, Tate DF, Walker WC, Levin HS, Wilde EA. **FreeSurfer 5.3 versus 6.0: Are volumes comparable? A Chronic Effects of Neurotrauma Consortium Study.** *Brain Imaging Behav.* 2020 Oct;14(5):1318-1327. doi: 10.1007/s11682-018-9994-x. PMID: 30511116.
- Wade BSC, Tate DF, Velez C, Dennis EL, Goodrich-Hunsaker NJ, Walker WC, Kennedy E, Hinds S, Taylor BA, Bigler ED, Abildskov TJ, Newsome MR, York GE, Betts A, Duncan T, Kenney K, Pugh MJ, Cifu DX, Wilde EA. **Mapping Post-traumatic Stress Disorder and Depressive Symptoms to Hippocampal Subfields and Amygdala Nuclei in Service Members and Veterans with Mild Traumatic Brain Injury.** Submitted July 2020 to *Neuroimage Clin.*
- Dismuke-Greer, CE, Hirsch, S, Carlson, KF, Pogoda, TK, Nakase-Richardson R, Bhatnagar, S, Eapen, BC, Troyanskaya, M, Miles SR, Nolen, T, Walker WC. **Health Services Utilization, Healthcare Costs, and Diagnoses by Mild Traumatic Brain Injury Exposure: A CENC Study.** *Arch Phys Med Rehabil.* 2020 Oct;101(10):1720-1730. doi: 10.1016/j.apmr.2020.06.008. Epub 2020 Jul 9. PMID: 32653582.



# Analytic Data-sets Recently Approved/Extracted

- Persistent Structural, Shape, and Diffusion Differences between TBI Clinical Groups and Their Functional Impact (Tate, D.; multiple analyses planned)
- Impact of Blast Exposure on Recovery Trajectory from mTBI (Bailie, J., Babakhanyan, I.)
- Military Occupational Specialties and Blast Exposure Risk Related to Health Outcomes (Bailie, J., Babakhanyan, I.)
- Striatal functional connectivity more than X years after deployment-related mild traumatic brain injury in veterans and its relation to symptoms of movement disorder (Newsome, M.)
- Sociodemographic and Mental Health Predictors of Arrests in Veterans and Service Members with Mild Traumatic Brain Injury: A CENC-LIMBIC Study (Miles, S.)
- Balance Phenotypes in mTBI (Fino, P.; 3 analyses)
- Influence of prior mild TBI and PTSD on Cognition in the LIMBIC-CENC multicenter cohort (O'Neil, M., Walker, W., Kean, J.; multiple analyses)
- Characterizing cognitive and functional profiles by dementia medical record code status within the CENC multicenter cohort (Walker, W.)
- Heterogeneity in Brain Injury: An Investigation of the Efficacy of Qualitative Comparative Analysis in Structural Neuroimaging. (Hodges, C.)
- Is physical exercise and activity related to cognition and well-being after mTBI? A LIMBIC-CENC Multicenter Study (Walker, W.)
- CENC-LIMBIC Longitudinal Variables to merge with VINCI health economics study data (Dismuke, L.)
- ENIGMA Military Brain Injury (Dennis, E.)
- Recent preliminary approvals granted by the SRC:
  - Role of subconcussive head injury history in long-term neural integrity (Davenport, N.)
  - Alterations in functional and structural connectivity in patients with dizziness after TBI (Allen, J.)



# PLS Collaborations and Spin off Studies; research activities underway

- Sheerin, C (VCU). *Functional relations between alcohol use and mental/physical health in the wake of COVID-19 pandemic*. NIAAA K01 Supplement; genetic and learning-based mechanisms for AUD and PTSD. Status: awarded.
- Carlson, K (Portland VAMC). *Effects of Opioid and Other Psychotropic Drug Exposures on Long-term Outcomes of TBI: Developing Measurement Best Practices*. VA R&D, SPiRE. Funding status: awarded.
- Pugh, MJ. *The Epidemiology of Epilepsy and Traumatic Brain Injury: Severity, Mechanism, and Outcomes*". Dept. of Defense, Epilepsy Research Program, Idea Development Award. Funding awarded.
- Agyemang, A (Richmond VAMC). *The mediational role of sleep quality in the relationship between chronic mTBI and cognitive functioning*. NIH Diversity Supplement grant. Funding awarded.
- O'Neil, M (Portland VAMC). CDMRP W81XWH-19-PHTBIRP-FITBIRA. FITBIR: Accelerating Synthesis of TBI Research Using Novel Methods" (FAST RUN Methods). Status: awarded.
- Gore R, Allen J. (Emory University). Joint LIMBIC PLS analysis: *Alterations in functional and structural connectivity in patients with dizziness after TBI*. Seeking grant funding for more robust visual motion assessment in PLS.
- Fino, P (Univ. Utah); joint analysis of LIMBIC-CENC PLS data; Balance Phenotypes in mTBI.
- Ricardo, J. (VA Cooperative Studies Program). CSP #2018: GRIT clinical trial (Growth Hormone (GH) Replacement Therapy in Veterans with mTBI and Adult GH Deficiency). PLS sites/central involvement. Status: Awarded.

\*Other collaborations to be discussed by Dr Hinds and/or LIMBIC cores



# Other PLS Collaborations in formation (partial list\*)

- Brain Injury and Sport Concussion Institute at Univ. of Virginia, Exercise & Sport Injury Laboratory (EASIL), Jake Resch, PhD. Collaboration with NCAA and ROTC programs. Selected for oral presentation of project application entitled “Military and Tactical Athlete Research Study (MATARS)” to Medical Technology Enterprise Consortium (MTEC) Solicitation MTEC-21-01-WBH-002.
- Seattle VAMC and University of Washington TBI: planning for joint TBI fellowship linked to LIMBIC with a goal of RR&D CRA.
- NCAA-DoD Concussion Assessment, Research and Education (CARE) Consortium: Dialogue continues for collaboration opportunities. Tentatively planning a comparison analysis.
- Football Players Health Study (FPHS), Harvard, R. Zafonte: Dialogue continues for collaboration opportunities.
- NIDILRR TBI Model Systems of Care. Ongoing cross-membership by Drs. Cifu, Walker, and Richardson.
- Track TBI. Geoff Manley. (Col. Hines and/or Dr. Cifu will describe)

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