

Why TBI in Older Adults Has Unique Considerations

*When and How should Age be a
Unique Consideration to Improve
TBI Research and Care?*

Kristen Dams-O'Connor, PhD.
Director, Brain Injury Research Center
Vice Chair of Research
Jack Nash Professor of Rehabilitation Medicine
Professor of Neurology
Icahn School of Medicine at Mount Sinai



**Mount
Sinai**

*Brain Injury
Research Center*

Disclosures

Kristen Dams-O'Connor Receives/Received research support from:

Grant #1K01HD074651-01A1

National Institutes of Health (NIH)/National Institute of Child Health and Development (NICHD)

Grant # 1 U01 NS086625-01

National Institutes of Health (NIH)/National Institute of Neurological Disorders and Stroke (NINDS).National Institute on Child Health and Development (NICHD)

Grants # National Institute1RF1NS115268, RF1NS128961, 1R01NS102646-01, U54 NS107201, 1R01 NS115268-01, U54 NS115322-01, U54 NS115266-01; UG3NS117844, NS120249, 1U01NS137484

National Institutes (NIH)/National Institute of Neurological Disorders and Stroke (NINDS)

Grant # 1R01 AG061028-01

National Institutes of Health (NIH)/National Institute of Aging (NIA)

Grant #90DPTB0009, 90DPTB0028,

National Institute on Disability Independent Living and Rehabilitation Research (NIDILRR) TBI Model Systems of Care

Grant # 90DPHF0006

National Institute on Disability Independent Living and Rehabilitation Research (NIDILRR) TBIMS Collaborative Supplement

Grant # 90ARHF0008

National Institute on Disability Independent Living and Rehabilitation Research (NIDILRR) Advanced Rehabilitation Research Training Program

Grant #PCS-1604-35115

Patient Centered Outcome Research Institute (PCORI)

Grant # W81XWH2210999

Department of Defense CDMRP TBI and Psychological Health Research Program Focused Program Award

Grant # W81XWH-17-1-0330

Department of Defense CDMRP Peer Reviewed Alzheimer's Research Program Epidemiology of Military Risk Factors Award

Grant # DVBIC-W91YTZ-13-C-0015

Department of Defense – Defense and Veterans Brain Injury Center (DVBIC)

Grant # Pending (AZ170038)

Department of Defense CDMRP Peer Reviewed Alzheimer's Research Program Research Partnership Award

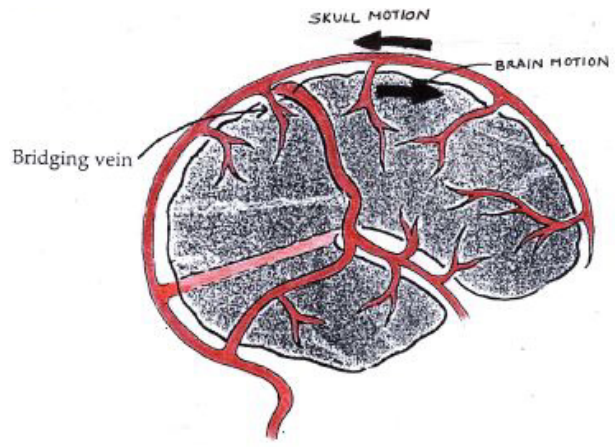
W81XWH-18-ERP-IDA

Department of Defense CDMRP Epilepsy Research Program

Kristen Dams-O'Connor serves on an advisory board and/or serves as a paid consultant to:

Brain Injury Association of America, New York Neurotrauma Consortium, Pink Concussions, Brown University, Veterans Affairs Medical Centers, various law firms.

Conflicts of interest: None.



Neurological: atrophy, reduced synaptic density,
 ↑ stress on bridging veins, decreased neural
 plasticity, reduced joint position sense, reduced
 cerebral perfusion

Musculoskeletal:
 reduced overall strength
 (20-30%), DJD, arthritis
 (48%), frailty

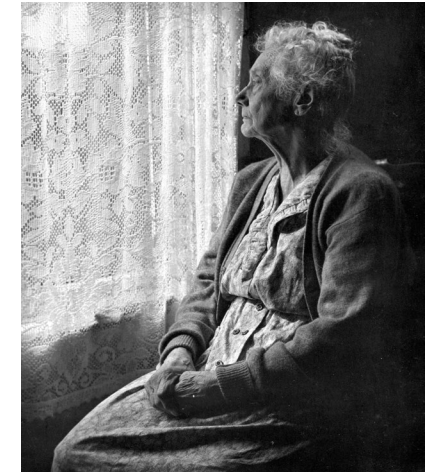


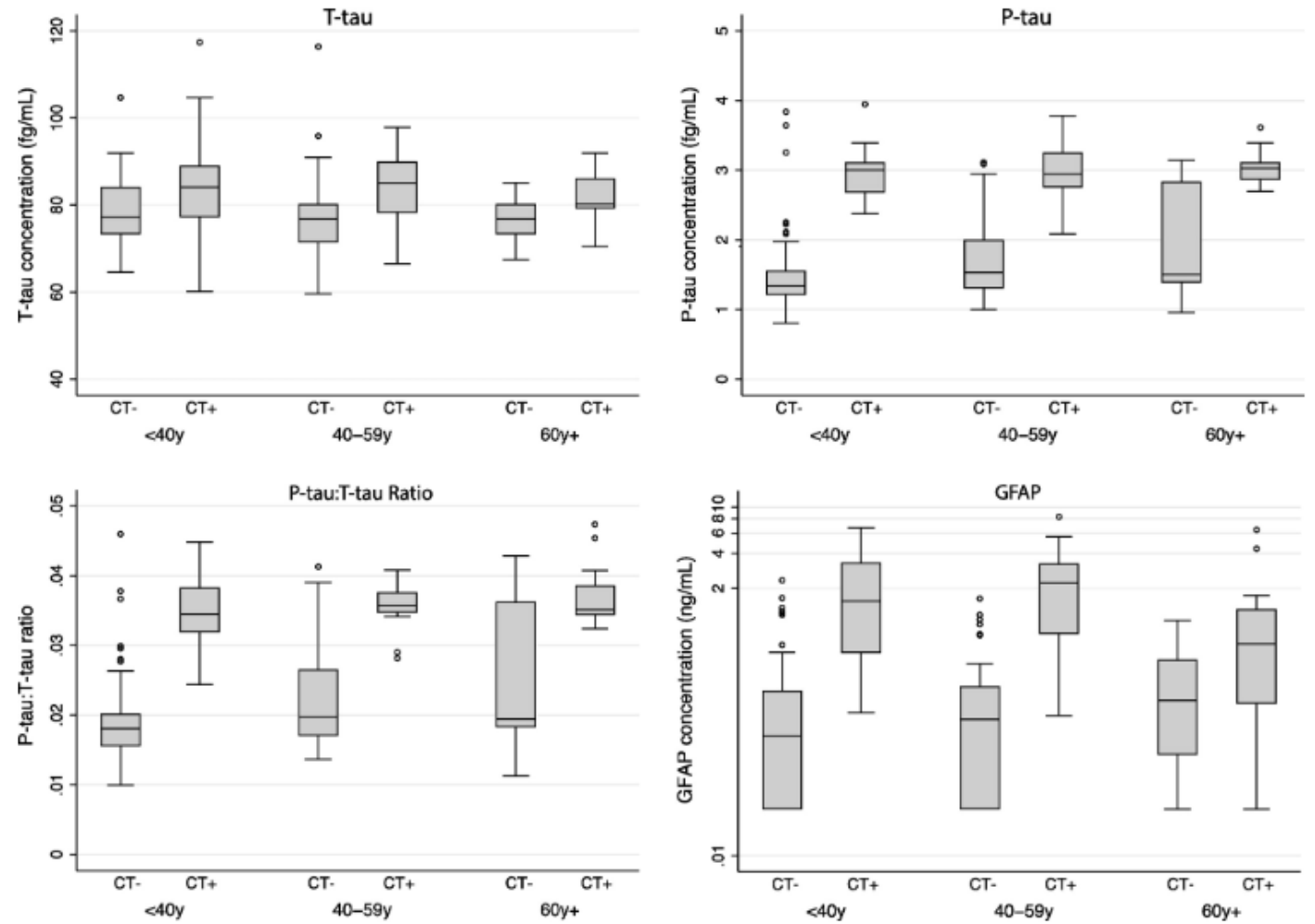
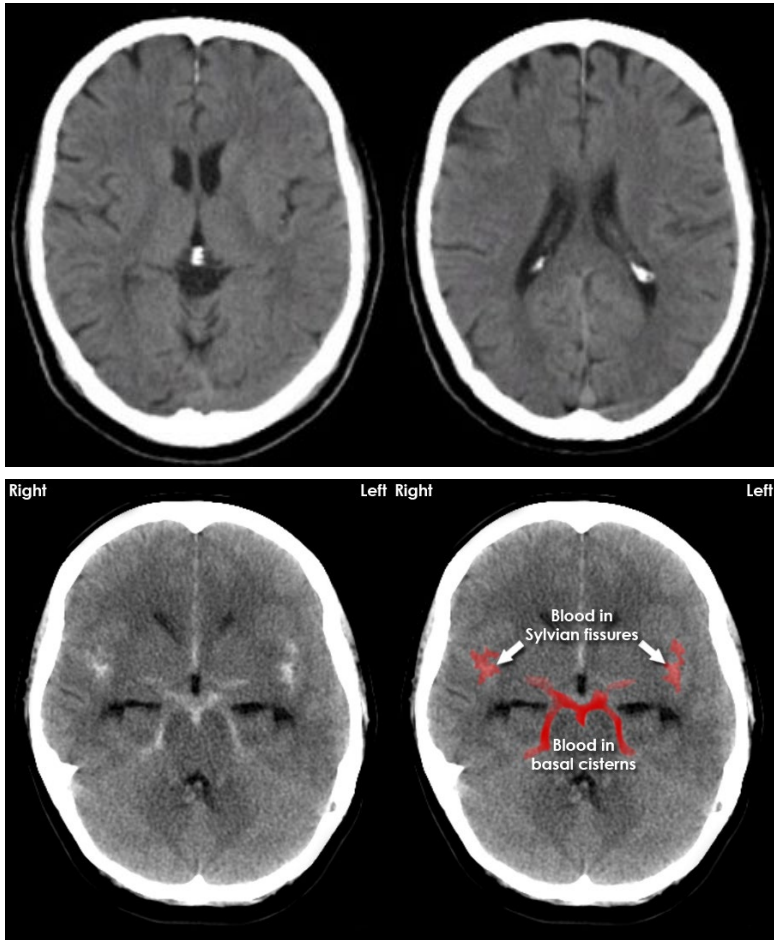
Cognition: slowed speed of
 processing, memory storage
 inefficiency (age 40)

Mood: depression,
 anxiety, fear of falling,
 social isolation



General Medical: endocrine dysregulation, reduced glucose
 tolerance, Hypertension (35%), CVD (27%), reduced vision (95%),
 hearing loss (25%, altered drug absorption, distribution &
 metabolism, immunologic changes, multi-morbidity, polypharmacy



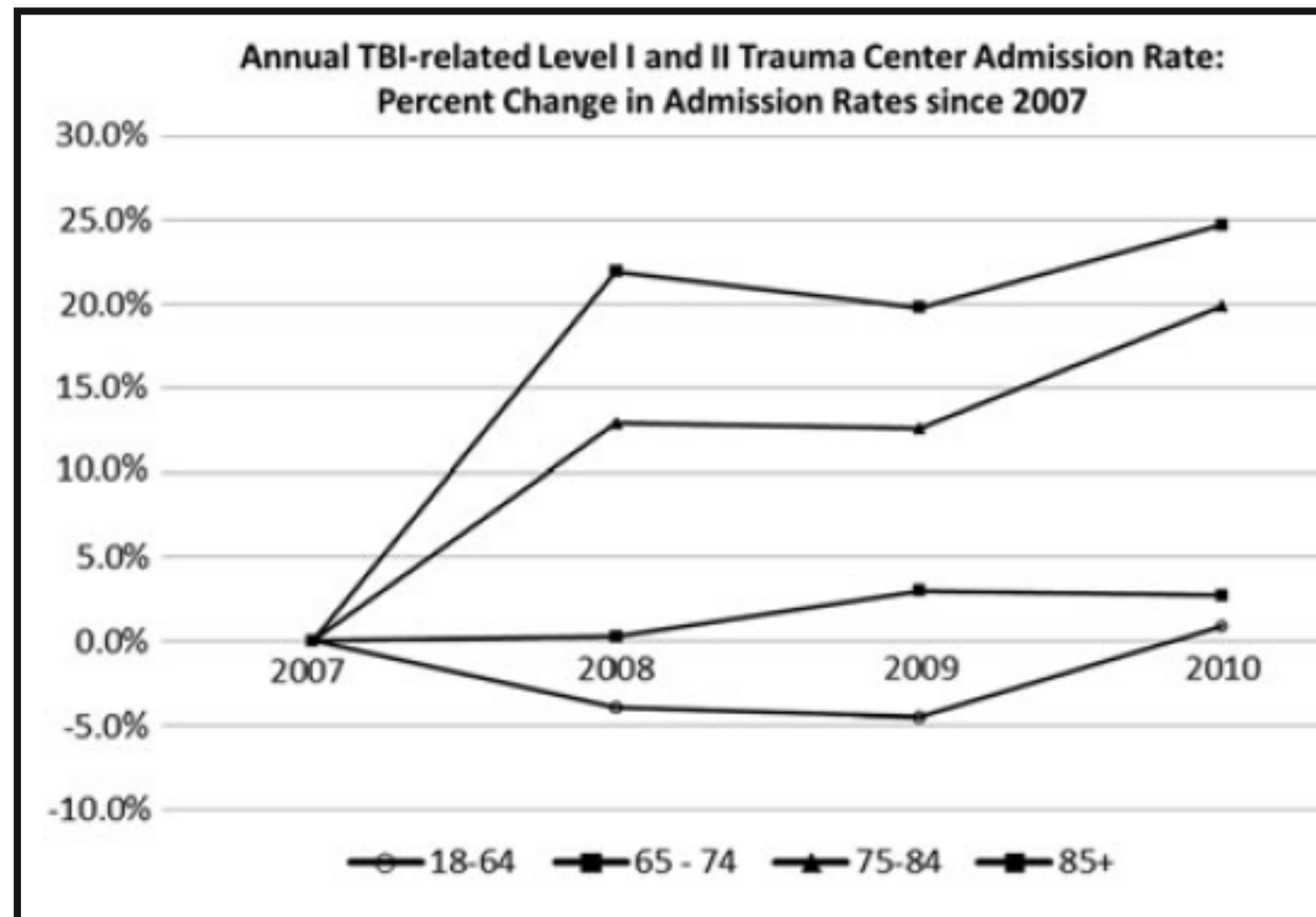


Blood-based biomarkers better distinguish CT+/CT- in younger adults

Traumatic Brain Injury among Older Adults at Level I and II Trauma Centers

Kristen Dams-O'Connor,¹ Jeffrey P. Cuthbert,² John Whyte,³ John D. Corrigan,⁴
Mark Faul,⁵ and Cynthia Harrison-Felix²

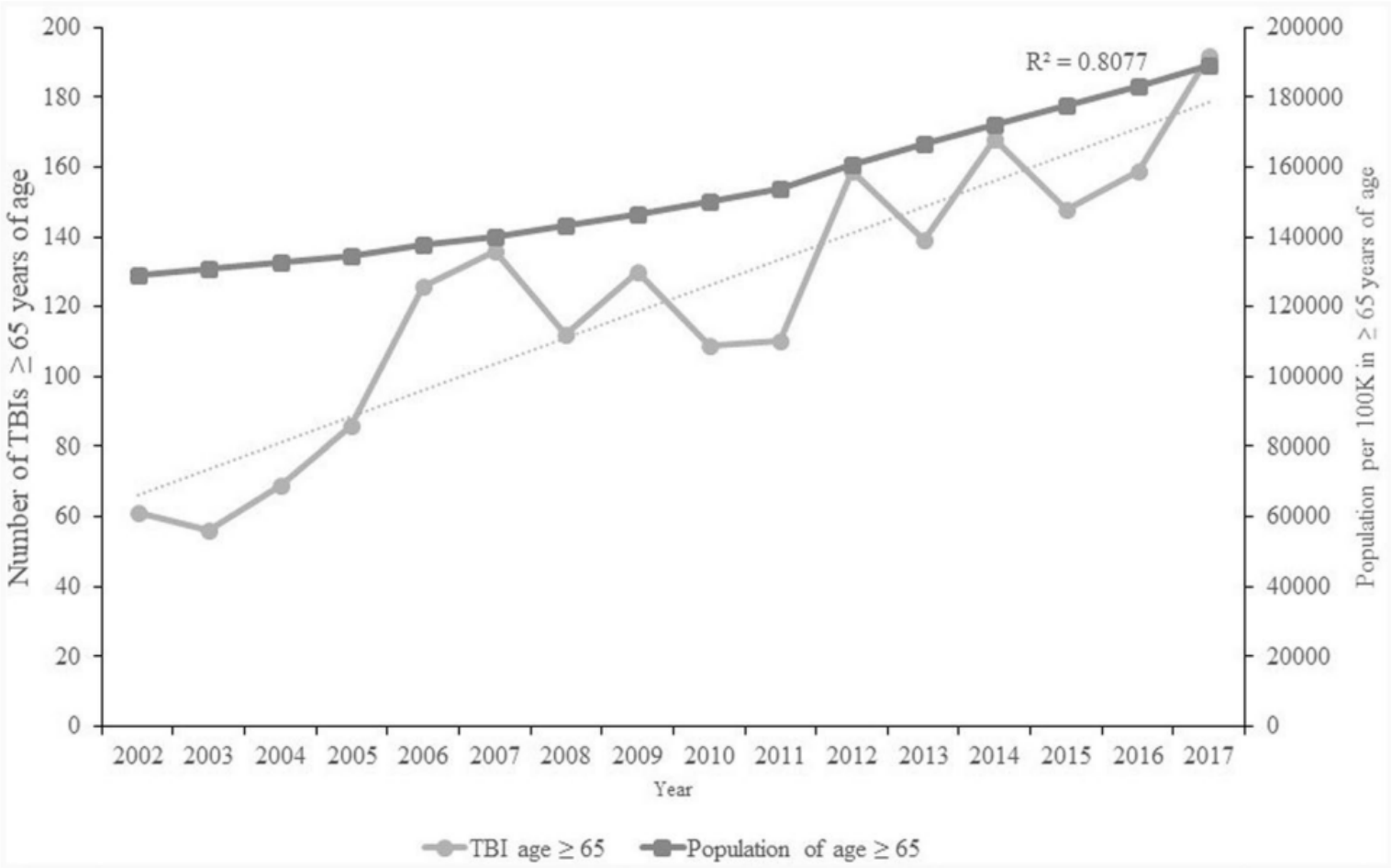
The rate of TBI-related hospital visits among the oldest segment of the U.S. population has exceeded population growth





Long-Term Trends in the Epidemiology of Major Traumatic Brain Injury

Nelofar Kureshi¹ · Mete Erdogan² · Ginette Thibault-Halman¹ · Lynne Fenerty¹ · Robert S. Green^{2,3} · David B. Clarke^{1,4}



YOUNG

OLD

20

30

40

50

65

60

70

80

90+

STAGES OF A CARE JOURNEY AFTER TBI

FOR MANY, THE JOURNEY IS NOT CONTINUOUS OR SMOOTH.

There can be bio-psycho-socio-ecological factors leading to:

- A missed or delayed diagnosis
- Difficulty accessing specialized care
- Loss of access to care over time

Some people who experience chronic symptoms will need long-term services and supports.

FOLLOW-UP

Continued engagement with the care system to identify and address ongoing and emerging needs, including provision of community-based support services.

RECOVERY AND REINTEGRATION

Recovery of function to the greatest extent possible, including return to family, community, work, or school.

CLASSIFICATION

Assessment of the nature and severity of a TBI to inform diagnosis, prognosis, and treatment. Includes reassessment as a person's condition evolves.

REHABILITATION

Interventions aimed at improving a person's physical, cognitive, and psychosocial functions and quality of life after a TBI.

ACUTE CARE

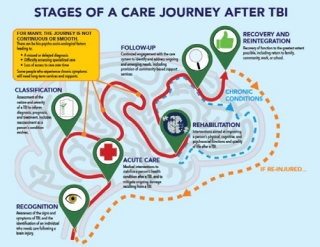
Medical interventions to stabilize a person's health condition after a TBI, and to mitigate ongoing damage resulting from a TBI.

RECOGNITION

Awareness of the signs and symptoms of TBI, and the identification of an individual who needs care following a brain injury.

CHRONIC CONDITIONS

IF RE-INJURED...



Causes of TBI in adults over age 65

TABLE 3: ESTIMATED NUMBER AND RATE OF TRAUMATIC BRAIN INJURY–RELATED HOSPITALIZATIONS, BY AGE GROUP AND MECHANISM OF INJURY, 2014

Age Group	Motor vehicle crashes		Unintentional falls ^{††}		Unintentionally struck by or against an object		Other unintentional injury, mechanism unspecified ^{††}		Intentional self-harm		Assault		Other or no mechanism specified ^{§§}	
	No.	Rate (95% CI)*	No.	Rate (95% CI)*	No.	Rate (95% CI)*	No.	Rate (95% CI)*	No.	Rate (95% CI)*	No.	Rate (95% CI)*	No.	Rate (95% CI)*
0-17	5,830	7.9 (6.9-9.0)	7,935	10.8 (9.4-12.2)	1,985	2.7 (2.3-3.1)	3,135	4.3 (3.6-4.9)	##	##	1,535	2.1 (1.7-2.5)	2,595	3.5 (2.6-4.5)
0-4	870	4.4 (3.4-5.4)	4,700	23.6 (20.1-27.2)	510	2.6 (2.0-3.2)	785	3.9 (3.1-4.8)	##	##	960	4.8 (3.7-5.9)	1,140	5.7 (4.1-7.4)
5-14	2,395	5.8 (4.8-6.8)	2,270	5.5 (4.7-6.3)	980	2.4 (1.9-2.9)	1,435	3.5 (2.8-4.2)	##	##	195	0.5 (0.3-0.6)	955	2.3 (1.6-3.1)
15-24	12,925	29.4 (26.5-32.3)	3,910	8.9 (8.0-9.8)	1,070	2.4 (2.1-2.8)	3,060	7.0 (6.2-7.7)	280	0.6 (0.5-0.8)	3,125	7.1 (6.3-7.9)	2,050	4.7 (3.7-5.7)
25-34	11,050	25.4 (22.9-27.9)	4,470	10.3 (9.3-11.2)	635	1.5 (1.2-1.7)	2,600	6.0 (5.3-6.7)	440	1.0 (0.8-1.2)	4,320	9.9 (8.8-11.0)	1,965	4.5 (3.6-5.5)
35-44	7,305	18.1 (16.2-19.9)	5,640	13.9 (12.8-15.0)	610	1.5 (1.2-1.8)	2,255	5.6 (4.9-6.2)	340	0.8 (0.6-1.0)	2,865	7.1 (6.3-7.9)	1,920	4.7 (3.9-5.6)
45-54	8,490	19.6 (17.6-21.5)	12,010	27.7 (26.0-29.4)	685	1.6 (1.3-1.9)	3,140	7.2 (6.5-8.0)	350	0.8 (0.6-1.0)	3,290	7.6 (6.8-8.4)	2,775	6.4 (5.4-7.4)
55-64	7,280	18.2 (16.5-19.9)	18,490	46.2 (43.8-48.6)	765	1.9 (1.6-2.2)	3,165	7.9 (7.1-8.7)	145	0.4 (0.2-0.5)	1,780	4.4 (3.9-5.0)	4,215	10.5 (9.2-11.8)
65-74	4,485	17.0 (15.3-18.7)	25,235	95.6 (91.4-99.9)	790	3.0 (2.5-3.5)	2,180	8.3 (7.4-9.1)	85	0.3 (0.2-0.5)	535	2.0 (1.6-2.4)	5,085	19.3 (17.2-21.4)
75+	3,965	20.0 (18.0-22.0)	74,005	373.2 (358.3-388.1)	1,045	5.3 (4.5-6.0)	2,550	12.9 (11.7-14.1)	70	0.4 (0.2-0.5)	325	1.6 (1.2-2.0)	11,360	57.3 (51.4-63.2)
Total	58,765	18.4 (16.9-20.0)	150,730	47.3 (45.5-49.1)	7,090	2.2 (2.1-2.4)	21,170	6.6 (6.2-7.1)	1,730	0.5 (0.5-0.6)	17,395	5.5 (5.0-5.9)	31,465	9.9 (8.8-11.0)
Adjusted[¶]		18.2 (17.4-18.9)		43.9 (42.9-45.0)		2.2 (2.1-2.3)		6.5 (6.2-6.7)		0.6 (0.5-0.6)		5.5 (5.3-5.8)		9.3 (8.8-9.8)

PROPOSED CBI+M FRAMEWORK: FIRST 24 HRS



C

B

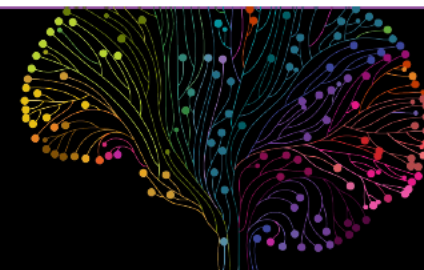
I

M

PILLAR	BASIC COMPONENTS	EXPANDED COMPONENTS
CLINICAL	GCS (3-15) + Motor, Verbal, Eye Pupillary Reactivity Confounds to assessment Reasons for untestable	Classical Signs (with Duration): PTA/LOC/AMS Other Acute Neurological Signs Standardized assessment of symptoms, cognition, VOM, balance, other
BIOMARKERS	Acute Biomarker Levels (when available): GFAP, UCH-L1, S100B	Biomarker Modifiers Important to Interpretation (neurologic d/o, extracranial injury, age, melanoma, sampling time)
IMAGING	CT findings of Common Acute TBI Pathologies; Mass effect & Lesion Volume > or < 25 ml	Expanded characterization of TBI pathologies (location, volume), skull fracture (type, w/wo ICI), mass effect (edema, swelling), tSAH, vascular injury, incidental findings
MODIFIERS	Traumatic Injury Factors, Patient Factors, Community/Society Factors	More comprehensive characterization of traumatic, patient, psychosocial-environmental factors that influence TBI management, recovery and outcome

*Improved Characterization of Injury, Classification of Severity,
Consideration of Factors Influencing Outcome*

M: MODIFIER PILLAR



- Evidence on influence of injury AND non-injury factors on recovery & outcome after TBI
- Multidimensional Factors: Injury + Patient + Psychosocial-Environmental
- Confounds to acute assessment of patients
- Bias on clinical decision management

PROPOSED MODIFIERS COMPONENTS

CORE COMPONENTS:

- TRAUMATIC INJURY FACTORS: mechanism, extracranial injury, stressful circumstances
- PATIENT FACTORS: age, sex, history (medical, TBI, psych, developmental), language/comm barriers
- COMMUNITY/SOCIETAL FACTORS: social disadvantage/deprivation, health care coverage

EXPANDED COMPONENTS:

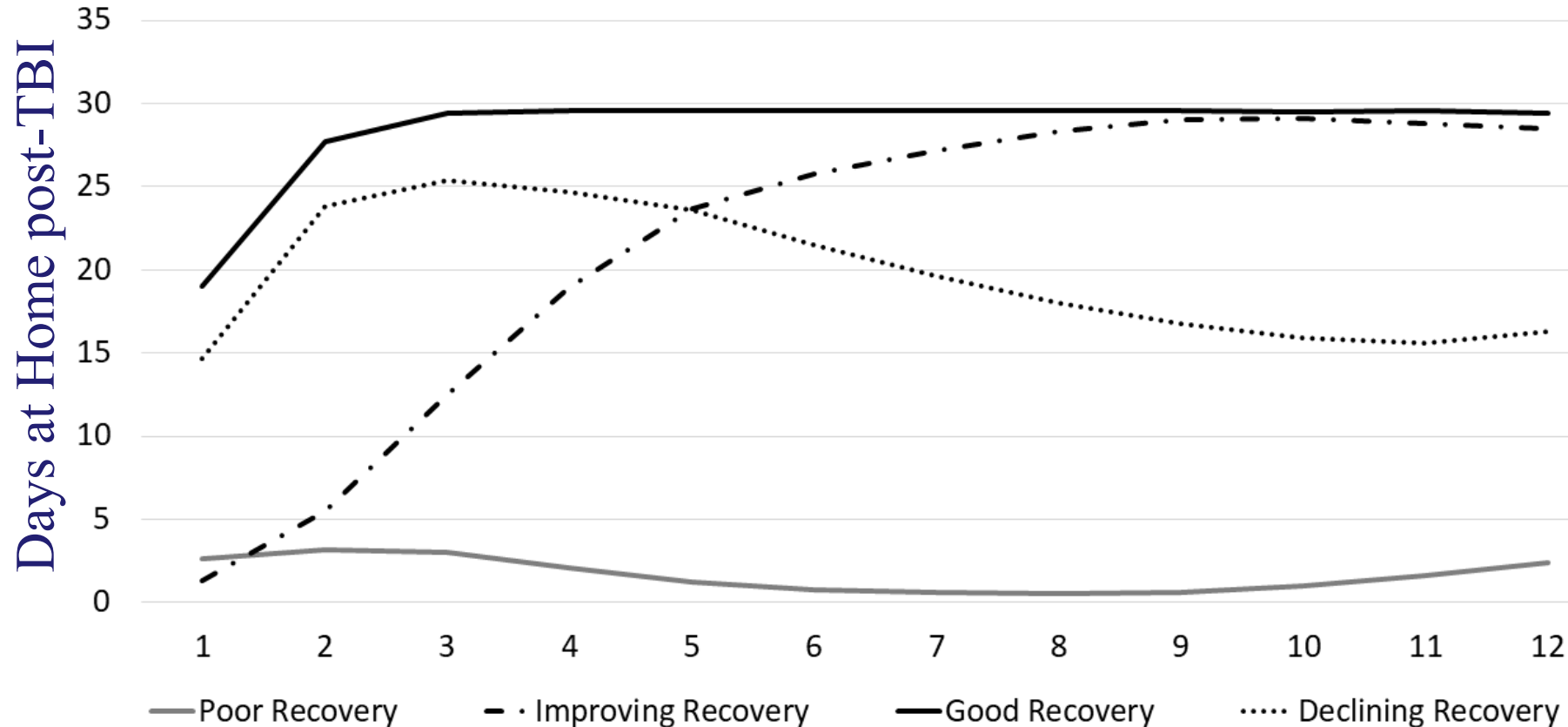
- More detailed record of mechanism, extracranial injury (AIS), trauma circumstances, individualized patient factors, psychosocial factors, living circumstances, social barriers

*Confounds to acute assessment (sedation/ventilation, intoxication) in "C" Pillar



Most Older Adults Recover Well after TBI

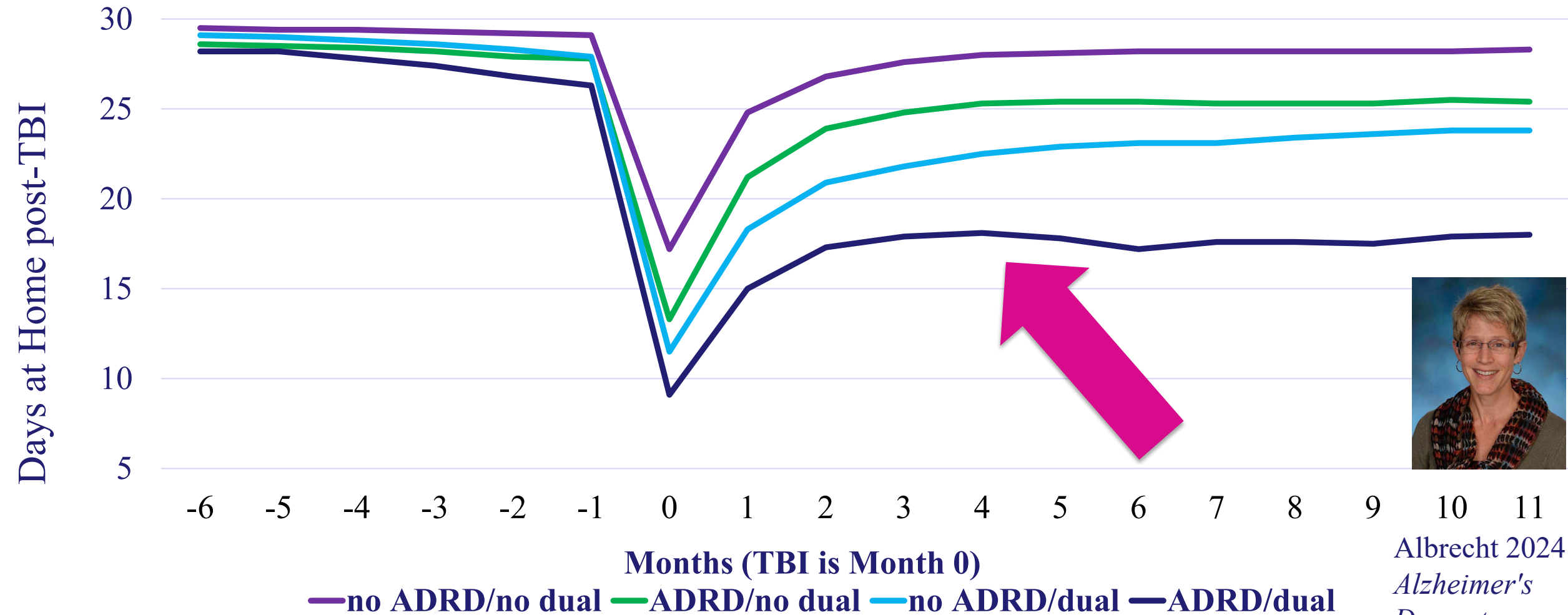
Average Monthly Time at Home over One Year Following Hospitalization for Traumatic Brain Injury among Older Medicare Beneficiaries 2010-2018 by Trajectory Group, n=20,350



Community dwelling older adults hospitalized with TBI: **80% achieved almost full recovery** of days spent at home within 6 months

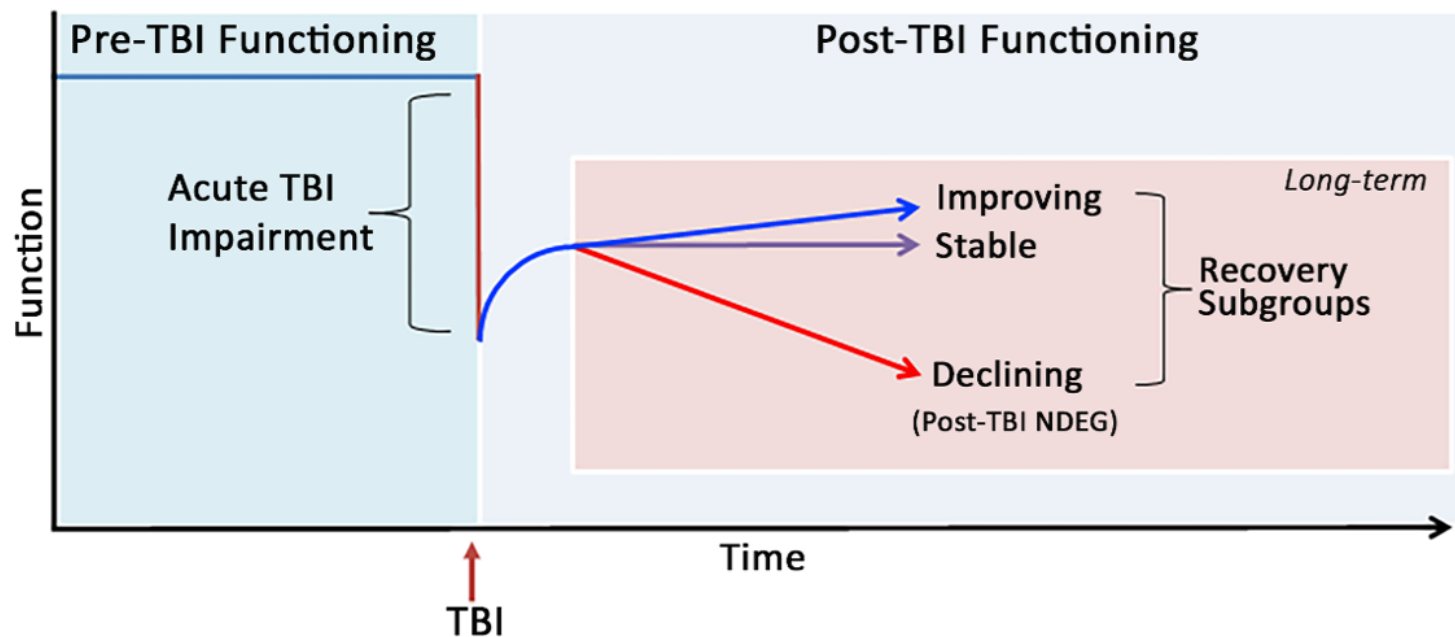


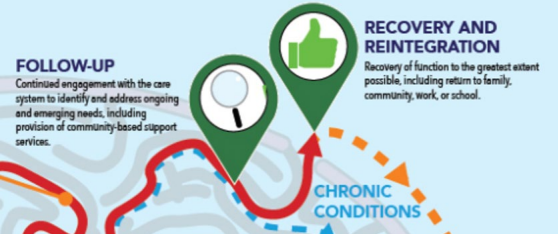
Older TBI survivors with Alzheimer's Disease and Related Dementias (ADRD) may be especially vulnerable to loss of home time if socioeconomically disadvantaged (dual)





ALZHEIMER'S DISEASE-RELATED DEMENTIAS SUMMIT 2022



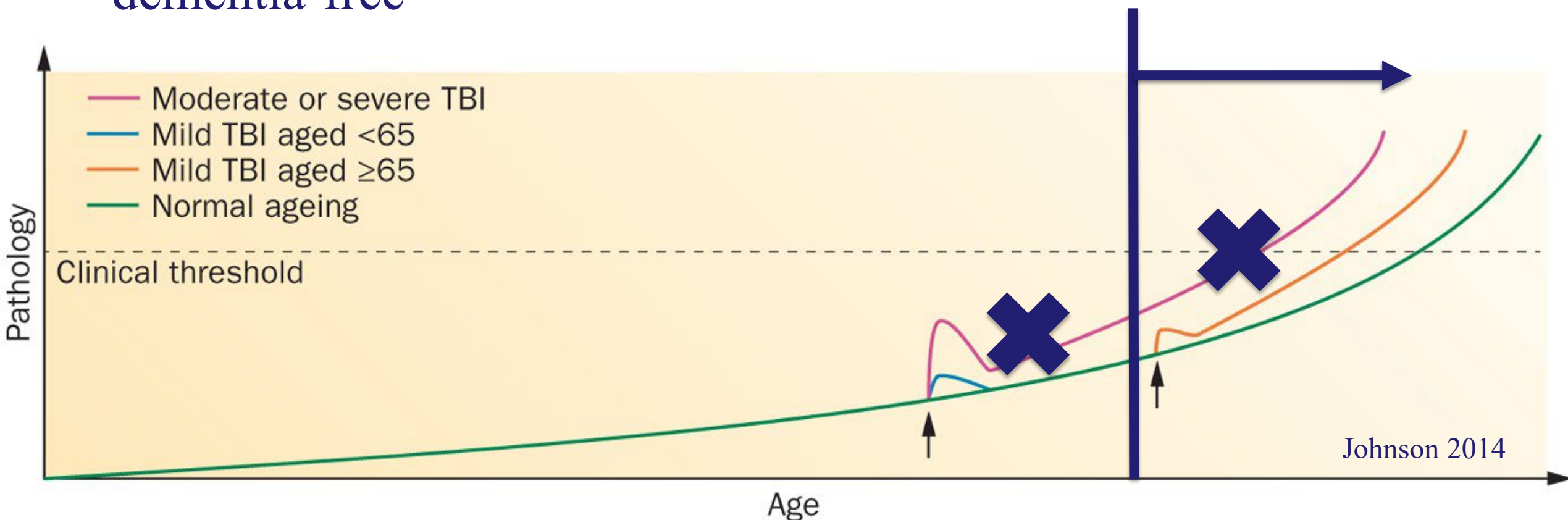


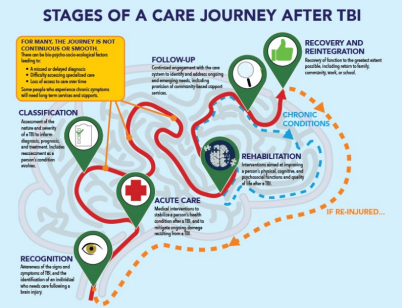
Prospective studies of cognitive aging

- Age 65+
- “dementia-free”

 **RUSH UNIVERSITY**

- Memory and Aging Project
- Minority Aging Research Study
- Religious Orders Study





- Memory and Aging Project
- Minority Aging Research Study
- Religious Orders Study

Dementia risk:

Risk for AD, all-cause dementia, and AD neuropathology is no greater than uninjured peers

Incident TBI risk:

- Early life TBI
- ADL impairment
- Depression
- Cerebrovascular disease
- Frailty

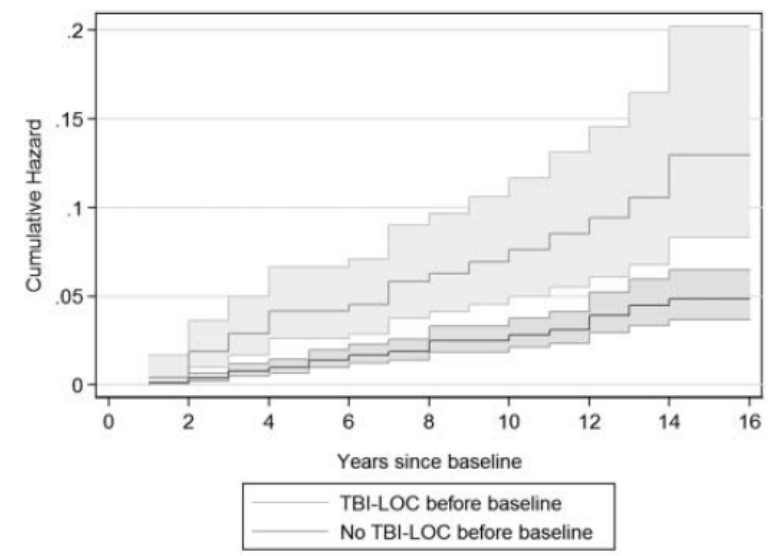


Figure 2 Nelson-Aalen cumulative hazard estimates for traumatic brain injury (TBI) with loss of consciousness (LOC) reported at follow-up visits, with 95% confidence bands.

The **clinical** and **neuropathological** features of dementia among those with a history of TBI is *different*



Kaiser Permanente Washington
Health Research Institute



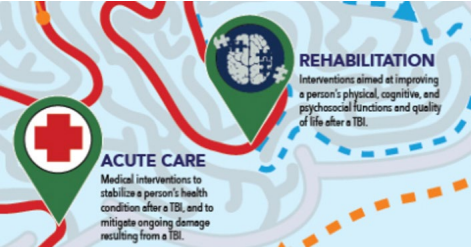
- Memory and Aging Project
- Minority Aging Research Study
- Religious Orders Study

UCSF Weill Institute for | Memory and
Neurosciences | Aging Center

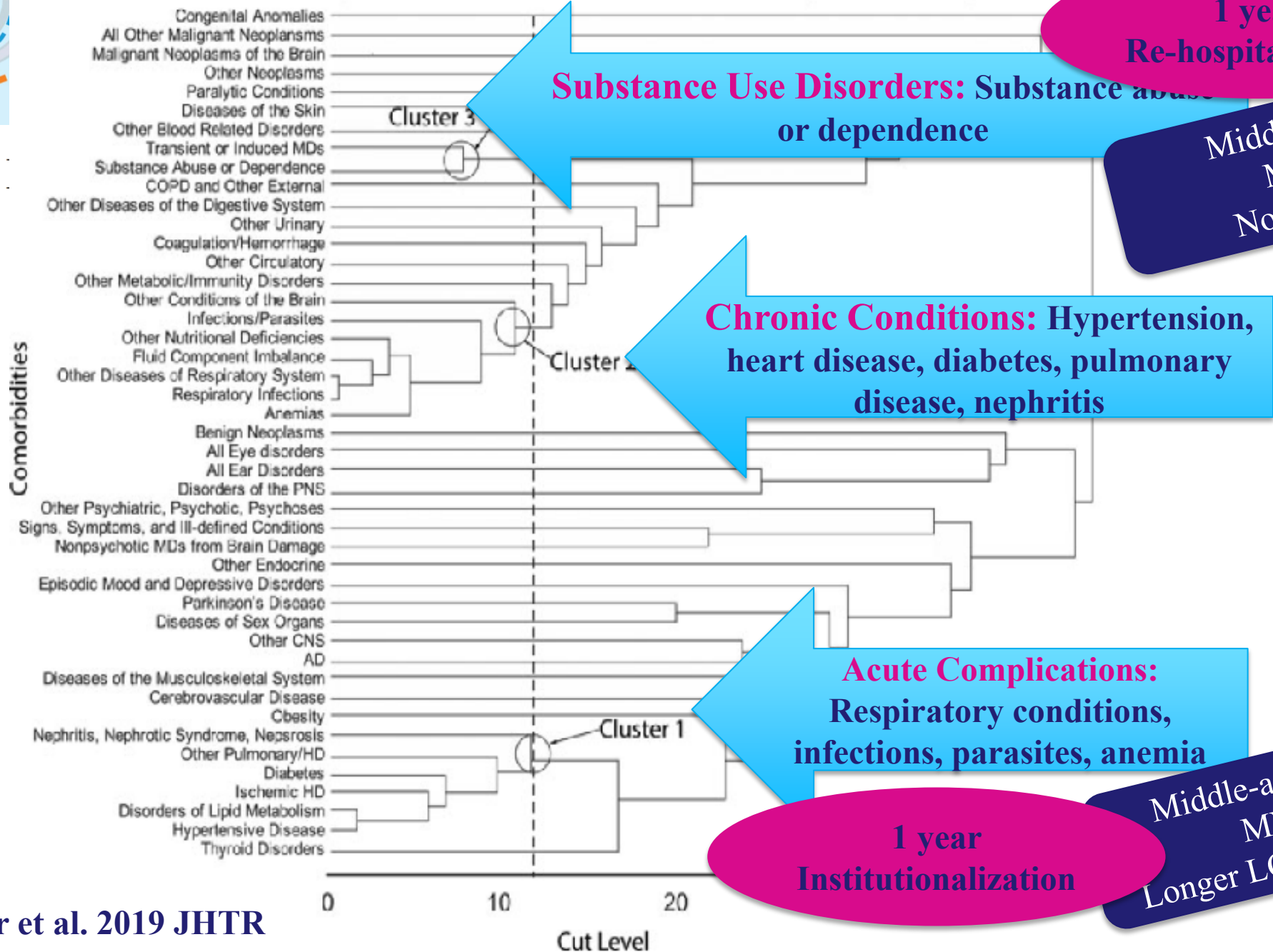
Brain Aging in Veterans (BRAVE)



THE NIA ALZHEIMER'S DISEASE RESEARCH CENTERS PROGRAM
National Alzheimer's Coordinating Center



Treelet Dendrogram for all 45 ICD-9 Comorbidities Among TBI Patients (n=2,134)



Kumar et al. 2019 JHTR

Original Research

Home, but Homebound after Traumatic Brain Injury: Risk Factors and Associations with Nursing Home Entry and Death

Homebound =
leave home <1-2 days/week

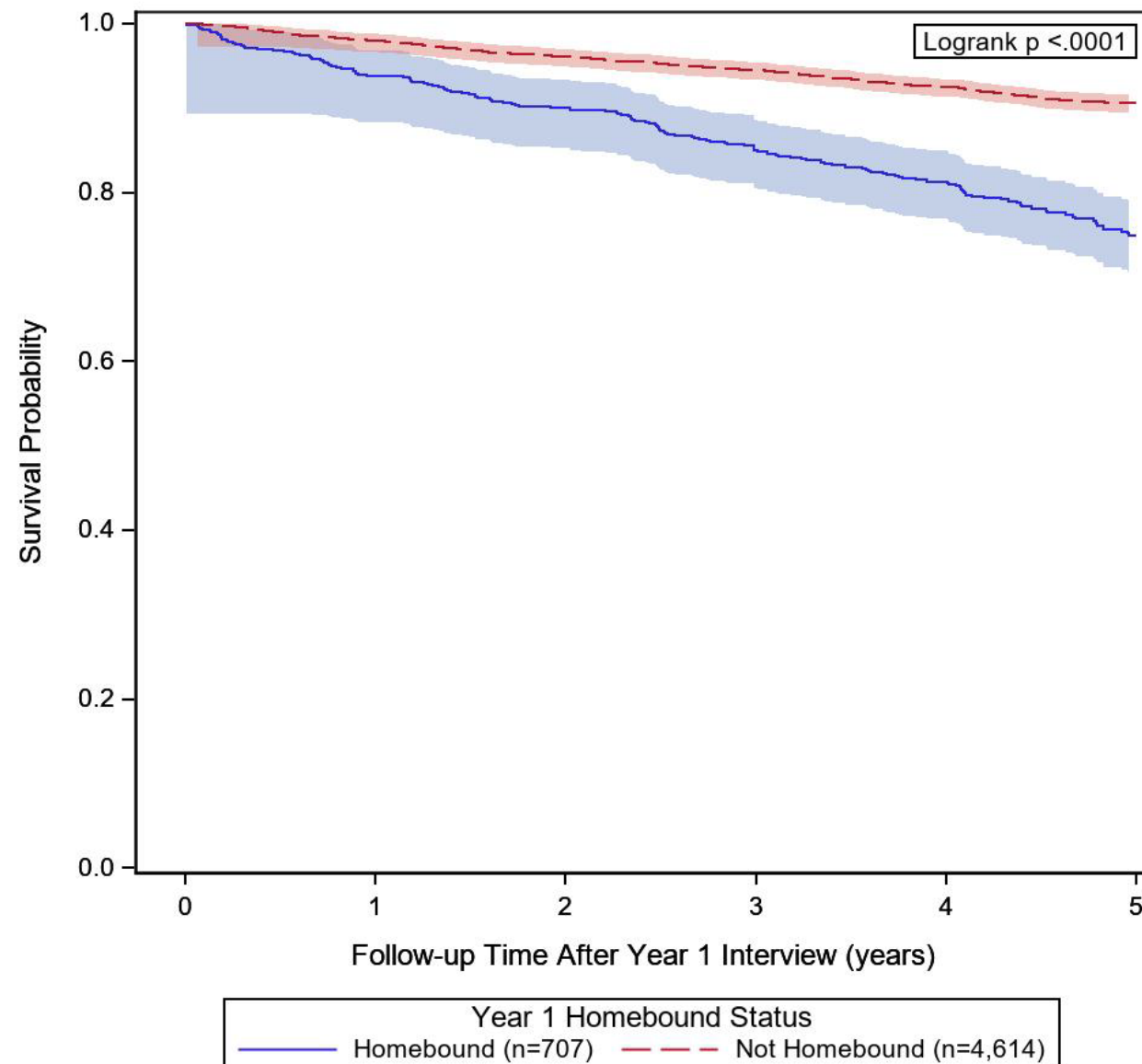
Being homebound:
**1.69x greater risk of 5y
mortality**

CMS Impact Act 2014

K-M survival curve for 5-year survival by Year-1 homebound status (n=5,165)

Product-Limit Survival Estimates

With 95% Hall-Wellner Bands





■ Creating new chronic condition category “Conditions that may cause cognitive impairment,” including the following sub-conditions: Alzheimer's disease, intellectual disabilities, developmental disabilities, **traumatic brain injuries**, disabling mental illness associated with cognitive impairment, and mild cognitive impairment;

(19) Conditions associated with cognitive impairment:

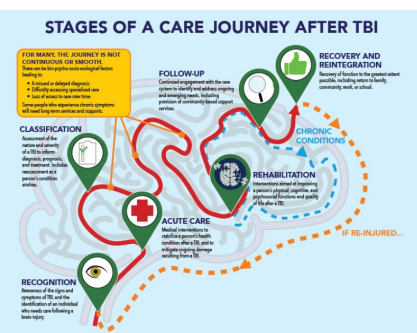
(i) Alzheimer's disease.

(ii) Intellectual disabilities and developmental disabilities.

(iii) Traumatic brain injuries.

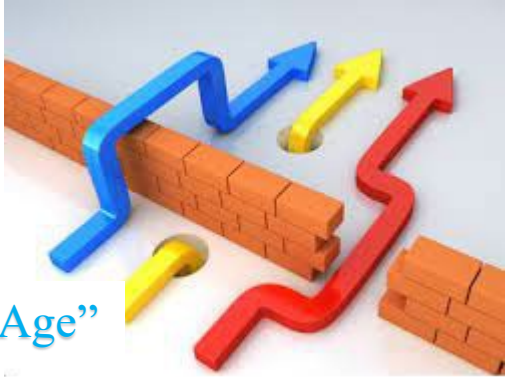
(iv) Disabling mental illness associated with cognitive impairment.

(v) Mild cognitive impairment.



C
B
I
M

PILLAR
CLINICAL
BIOMARKERS
IMAGING
MODIFIERS



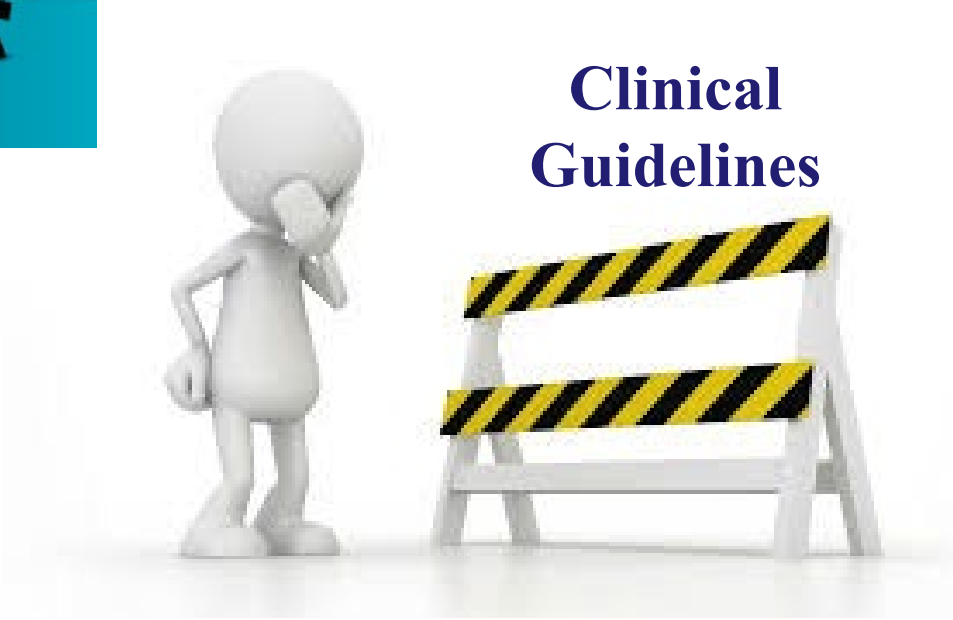
Screening & Diagnosis



Biological markers



Age in Care Triaging



Clinical Guidelines



Approaches to Address Unmet Research Needs in Traumatic Brain Injury Among Older Adults: A Workshop



Thank You
Kristen.Dams-O'Connor@mountsinai.org



Mount
Sinai

*Brain Injury
Research Center*



Thank You

Kristen.Dams-O'Connor@mountsinai.org



**Mount
Sinai**

*Brain Injury
Research Center*



@SinaiTBI



@BrainInjuryResearchCenter