

Frontiers in Chronic Pain Assessment: What the Future Holds

National Academies Workshop | SSA Committee

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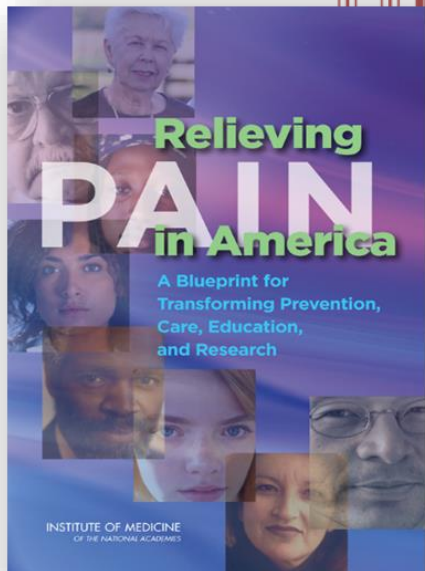
X/Twitter: @DrSeanMackey

No relevant disclosures

No industry COIs

Public Health Crisis of Pain

50M-100M Americans has Chronic Pain
20M have High-Impact Chronic Pain



Centers for Disease Control and Prevention

MMWR

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Pain Awareness Month — September 2018

September is Pain Awareness Month, when organizations work to raise awareness of how pain affects persons, families, communities, and the nation and to support national action to address pain. A 2011 Institute of Medicine report (<https://www.ncbi.nlm.nih.gov/pubmed/22553896>) has

Prevalence of Chronic Pain and High-Impact Chronic Pain Among Adults — United States, 2016

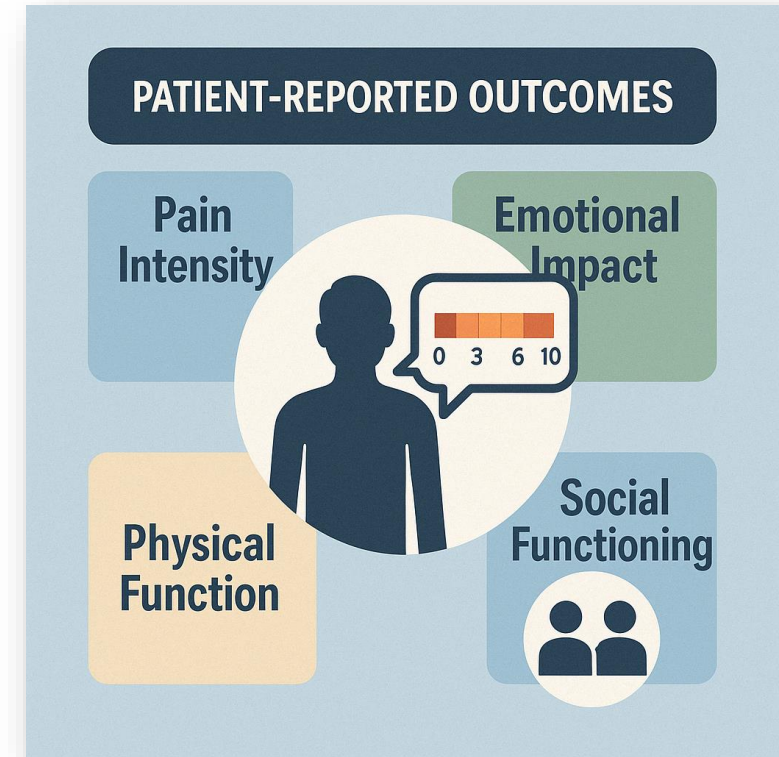
James Dahlhamer, PhD¹; Jacqueline Lucas, MPH¹; Carla Zelaya, PhD¹;
Richard Nahin, PhD²; Sean Mackey, MD, PhD³; Lynn DeBar, PhD⁴;
Robert Kerns, PhD⁵; Michael Von Korff, ScD⁴; Linda Porter, PhD⁶;
Charles Helmick, MD⁷

Emerging Tools & Technologies

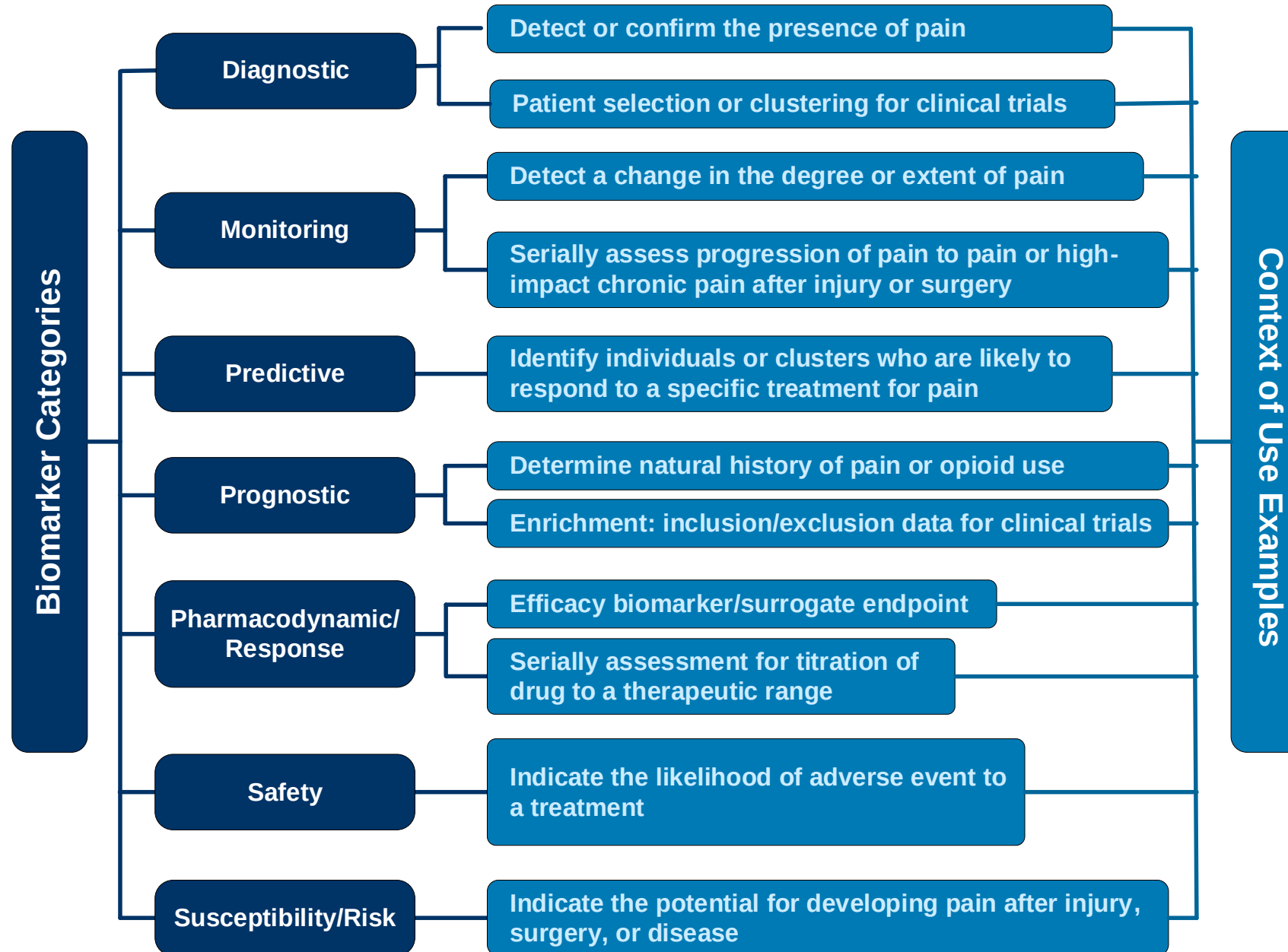
- Patient Reported Outcomes (PROs)
- Biomarkers
 - Multiomics
 - Wearables & Continuous Monitoring
 - Quantitative Sensory Testing (QST)
 - Neuroimaging (Brain, Spinal cord, Nerve)
- Learning Health Systems

Challenges and Opportunities: Patient-Reported Outcomes

- Traditional 0-10 pain intensity scale overly simplistic with moderate consistency
- Pain as biopsychosocial phenomenon and importance of context
- Unmet Needs:
 - Better capturing daily fluctuations (e.g. experiential momentary assessment)
 - Tools reflecting true lived experiences of patients
 - Integrating patient perspective with objective measures
- Foundation for exploring advanced measurement approaches

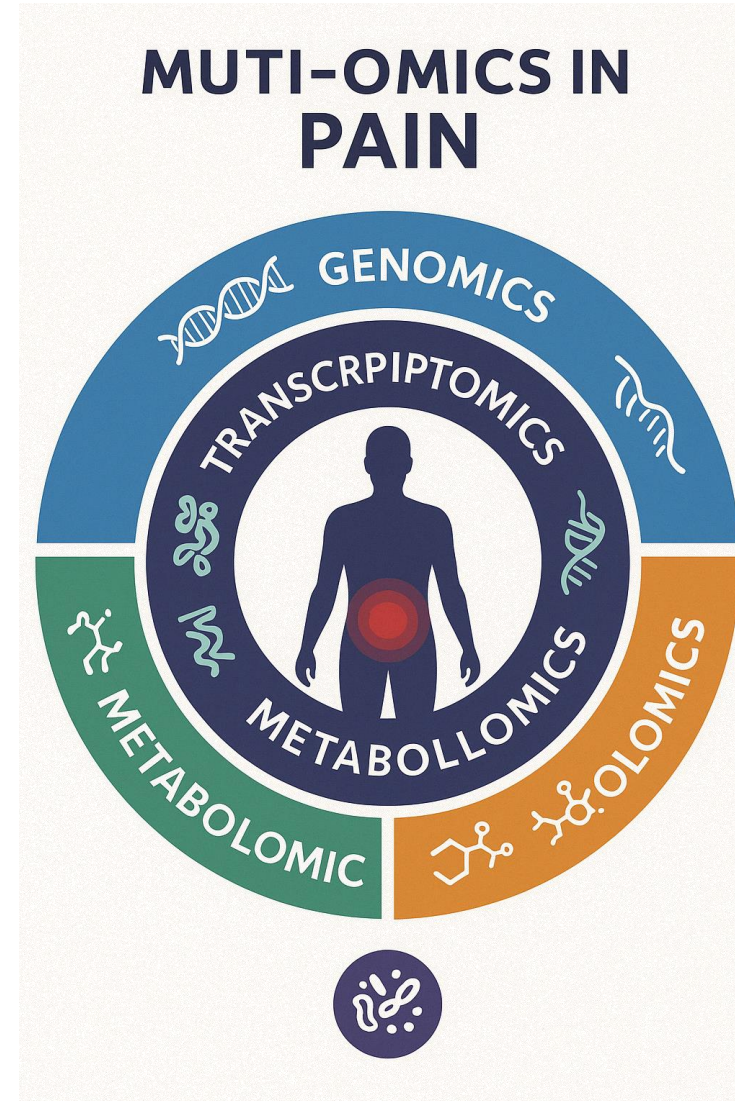


Pain Biomarker Categories and Examples of Use



Biomarkers & Multi-omics – Objective Evidence

- Biomarkers: Objective biological indicators of health or disease
- Multi-omic Biomarkers: Genetics, cytokines, proteomics, metabolomics, lipidomics, microbiome, etc
- No 'omic biomarker yet established as a reliable biomarker of chronic pain
- SSA Implication:
 - Future inclusion in medical records (biomarker panels)
 - Currently cautious interpretations



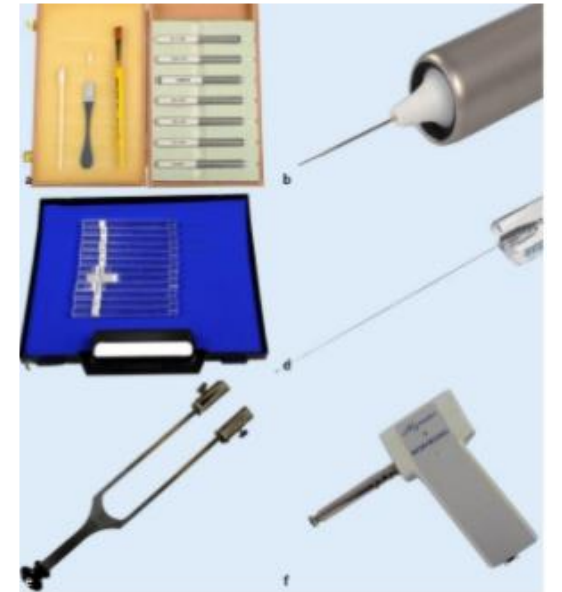
Wearable Technology – Real-Life Impact

- Track functions: steps, activity, HR, HRV
- Pain-linked changes in activity/sleep patterns
- Objective digital biomarkers of functional impairment
- SSA Implication:
 - Real-world evidence of pain's functional limitations



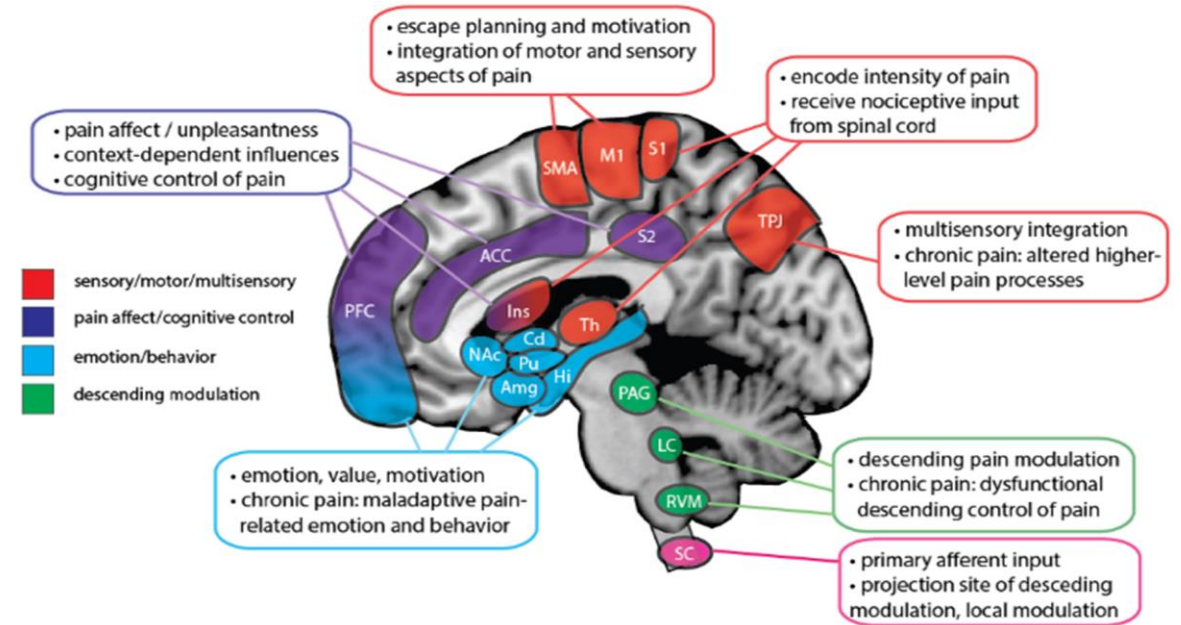
Quantitative Sensory Testing (QST)

- Standardized sensory testing (thresholds, sensitivity)
- Identifies pain mechanisms (neuropathic, inflammatory, central)
- Matches patients to targeted therapies
- SSA Implication:
 - Objective evidence of abnormal pain responses



Neuroimaging – Visualizing Pain

- Spinal Cord and Brain MRI/PET: “Pain signatures”
- Peripheral nerve imaging: Identifying pain sources
- EEG
- SSA Implication: Objective pain measures entering medical records



CONSENSUS
STATEMENT

OPEN

Brain imaging tests for chronic pain: medical, legal and ethical issues and recommendations

Karen D. Davis^{1,2,3}, Herta Flor⁴, Henry T. Greely⁵, Gian Domenico Iannetti⁶, Sean Mackey⁷, Markus Ploner⁸, Amanda Pustilnik^{9,10}, Irene Tracey¹¹, Rolf-Detlef Treede¹² and Tor D. Wager^{13,14}

NATURE REVIEWS | NEUROLOGY

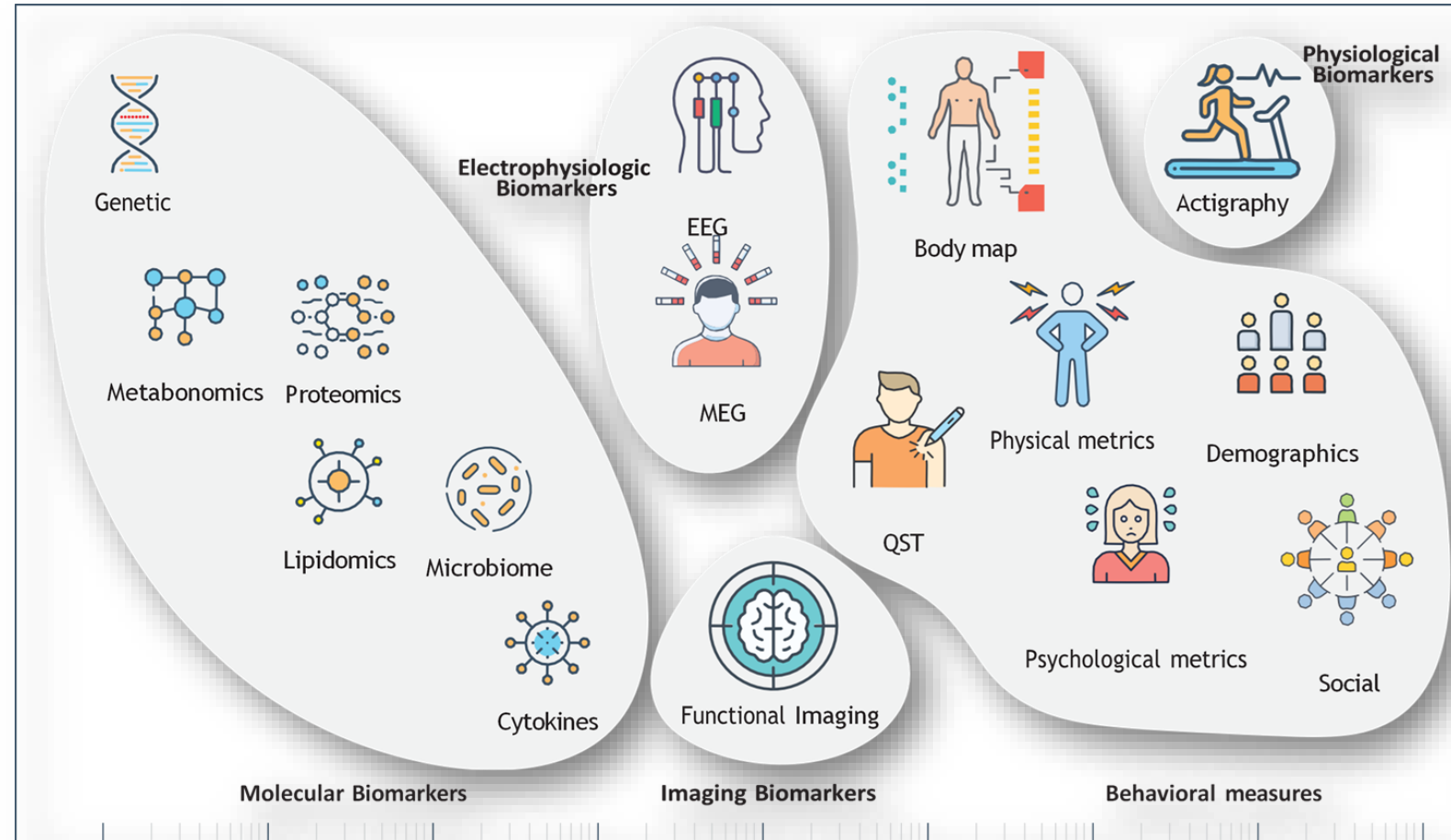
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Martucci and Mackey, *Anesthesiology* (2018)

Mercer, Chen, Gilam, Mackey, and Scherrer, *Science Translational Medicine* (2021)

Need for Composite Multi-Modal Biomarker Signatures

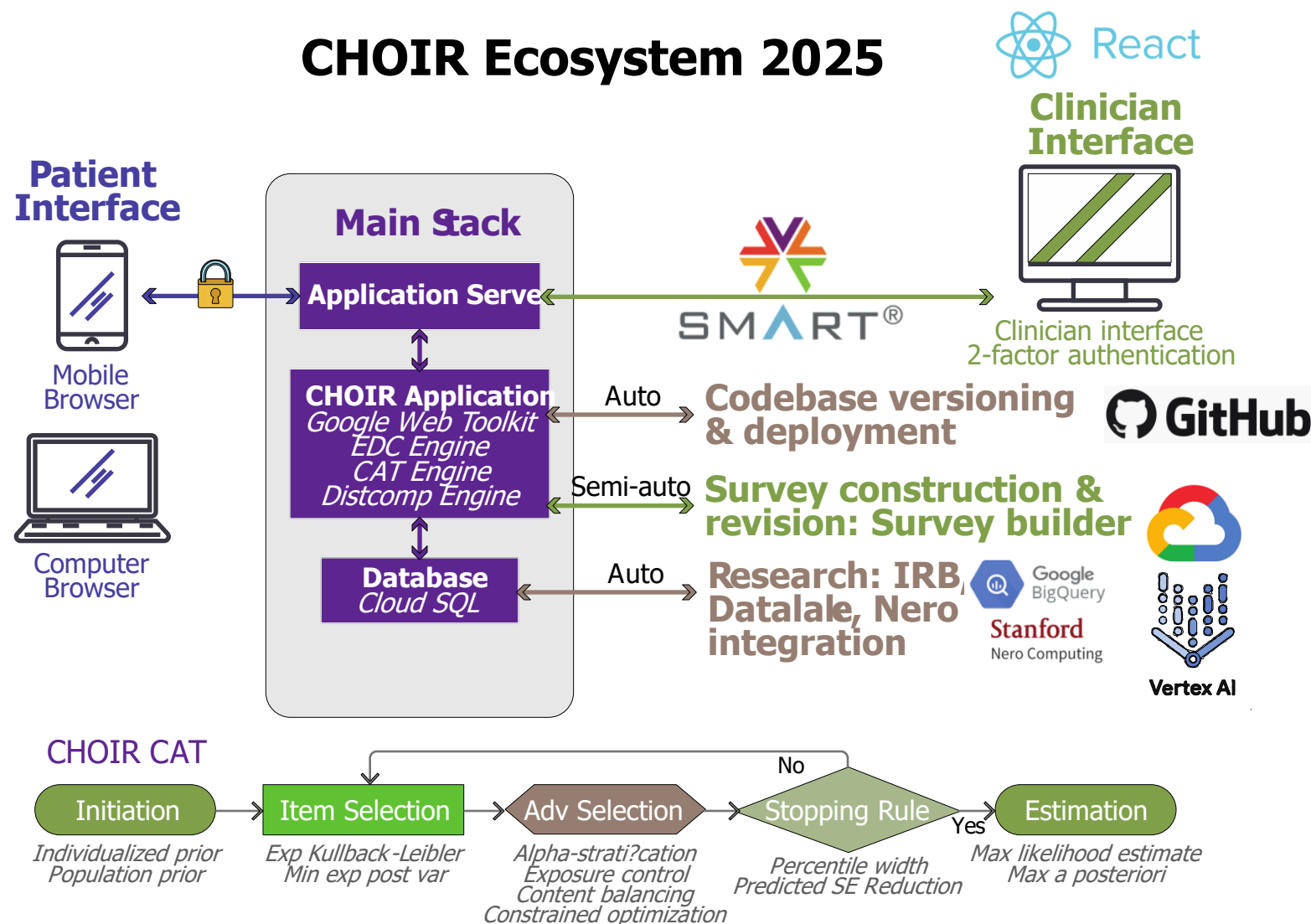


Mackey, S., et al, Innovations in Acute and Chronic Pain Biomarkers: Enhancing Diagnosis and Personalized Therapy, *Regional Anesthesia and Pain Medicine* (2024)



Open source, open
standard, flexible, and
free platform for a
Learning Health System
(<http://choir.stanford.edu>)

CHOIR Ecosystem 2025



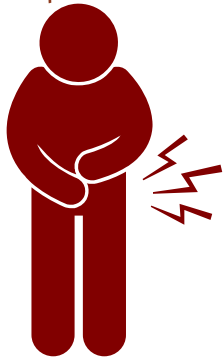
Learning Health System



Application of
precision
medicine



Point of Care:
The learning
engine



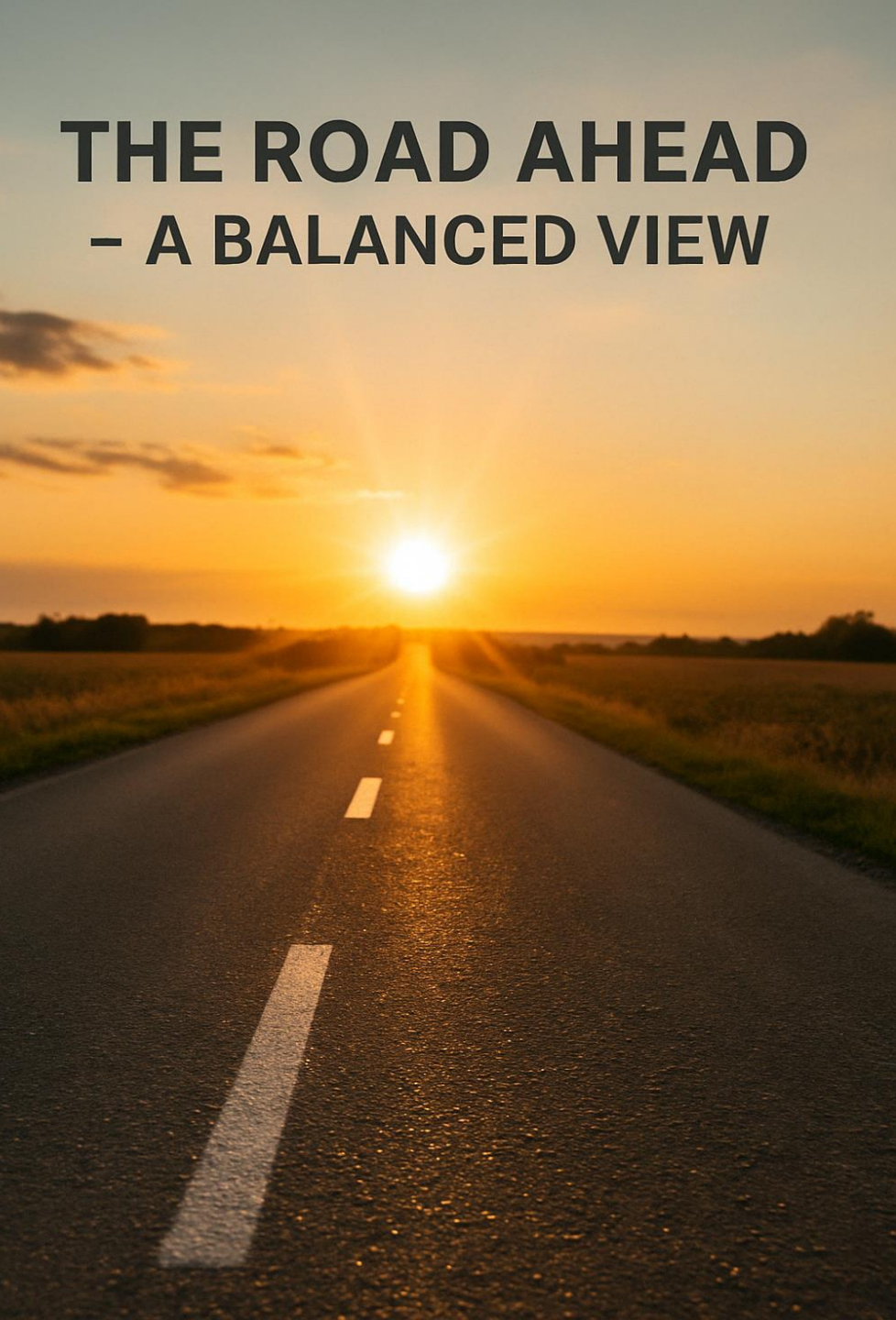
Biomarker
Signatures

Knowledge
network



Research influences practice
Practice influences research

Research
Studies



THE ROAD AHEAD

– A BALANCED VIEW

- New tools rapidly emerging, promising objectivity
- Many approaches still in research stages
- Future:
 - Multi-modal, objective chronic pain assessment and improved patient reported outcomes
 - Integration into learning health systems to make data actionable
- SSA to monitor validation and clinical acceptance

NIH HEAL grant: “Diagnostic and Prognostic Biomarkers of High-Impact Chronic Pain: Discovery and Validation” (NIH R61NS118651)

