

# Expanding Rapid Access to Low-Cost Perioperative & Chronic Pain Care via Brief Behavioral Interventions

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## **Beth Darnall, PhD**

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Psychiatry and Behavioral Sciences (by courtesy)

Wu Tsai Neurosciences Institute (affiliated faculty)

<http://bethdarnall.com>



Chief Science Advisor  
appliedVR

# Disclosures

Chief Science Advisor: AppliedVR



## Contracts and Grants

- NIH / NIDA Brief digital treatment for chronic pain
- PCORI Patient-Centered Opioid and Pain Reduction
- NIH / NCCIH Behavioral Treatment for Chronic Pain

### Board of Directors

- American Academy of Pain Medicine
- Institute for Brain Potential

### Scientific Member

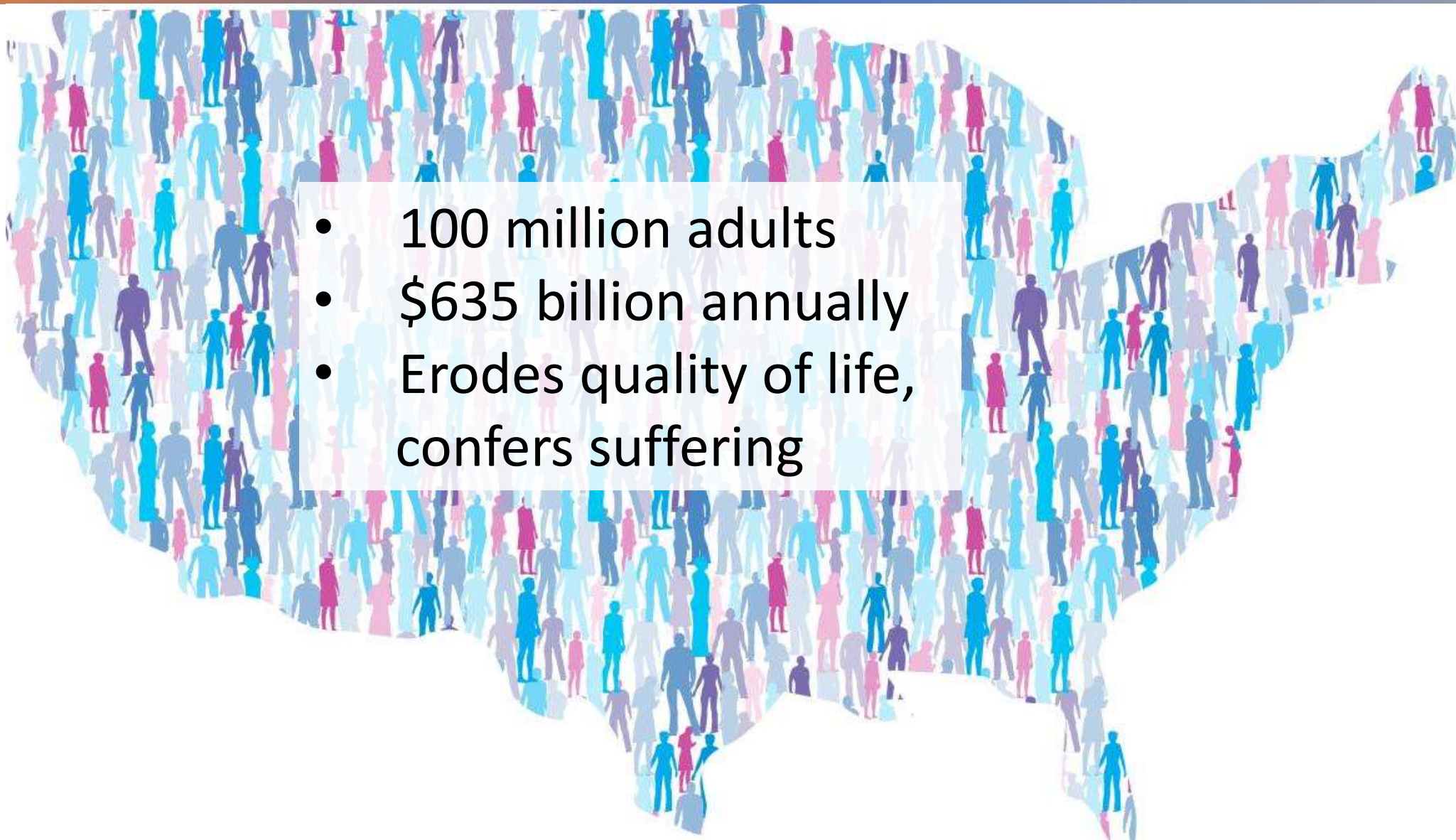
- CDC Opioid Workgroup
- NIH Interagency Pain Research Coordinating Committee (IPRCC)



# Behavioral Medicine for Pain

- (1) Treat the full definition of pain
- (2) Lowest risk treatments first
- (3) Apply targeted resources to those with residual needs
- (4) Engage patients as **active participants** in their pain care
- (5) Equip patients to control their experience of pain
- (6) Enhance medical, surgical, and health outcomes

# 2011 IOM Report: *Relieving Pain in America*

- 
- 100 million adults
  - \$635 billion annually
  - Erodes quality of life, confers suffering







International Association for the Study of Pain

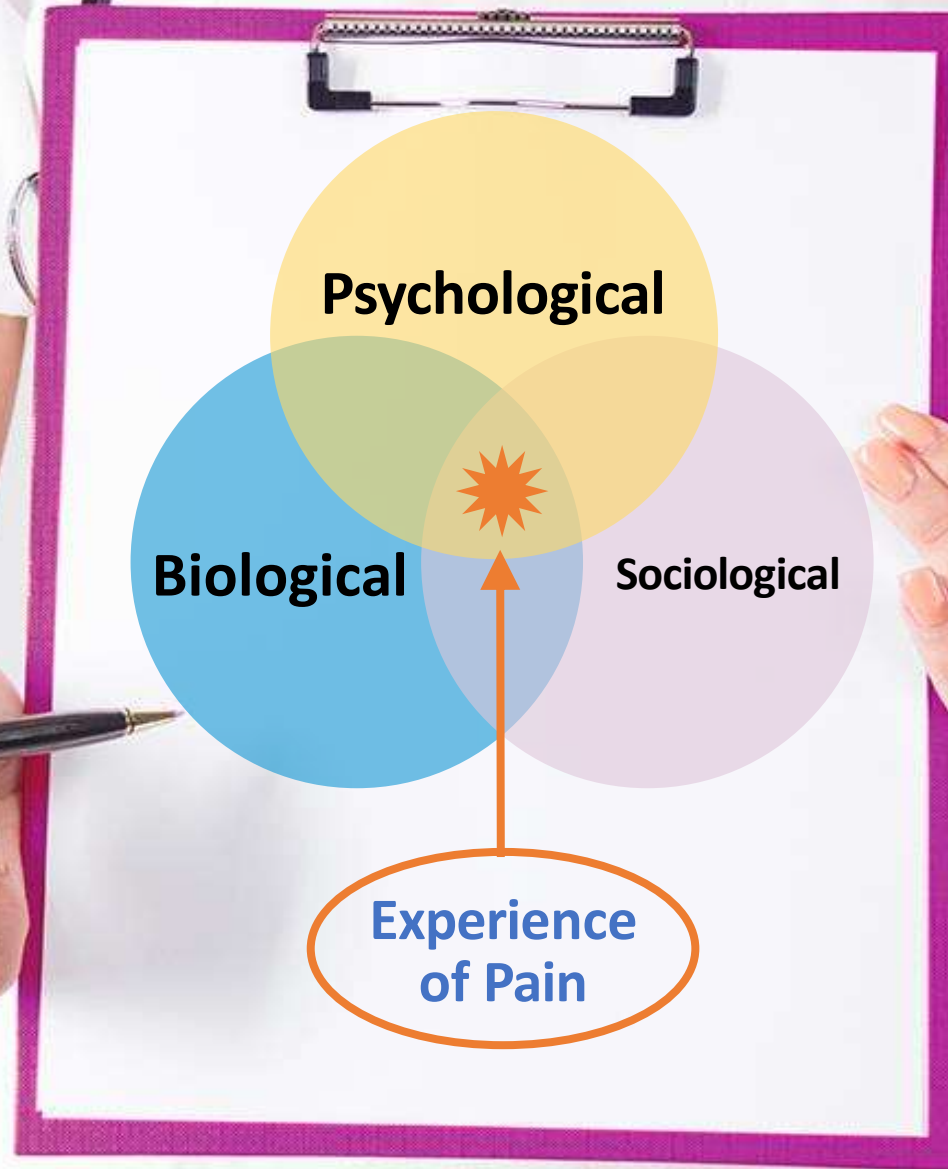
**IASP**

*Working together for pain relief*

Pain Definition: A noxious sensory **and emotional experience**



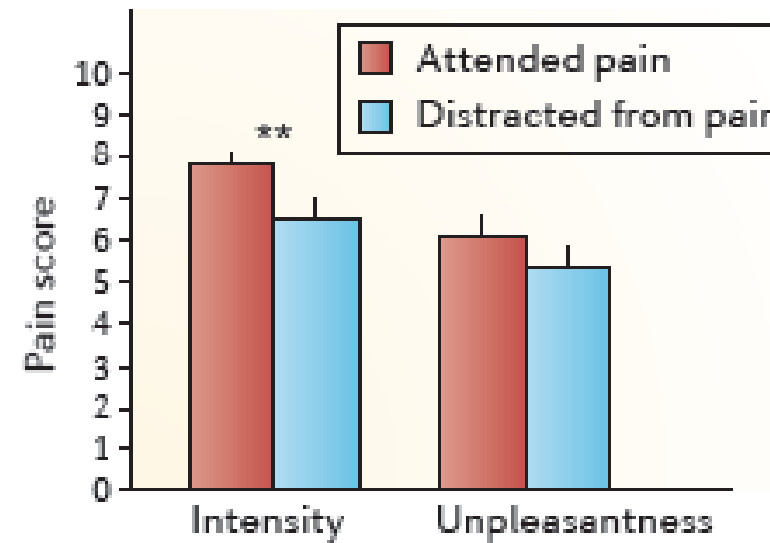
# The biopsychosocial model of pain



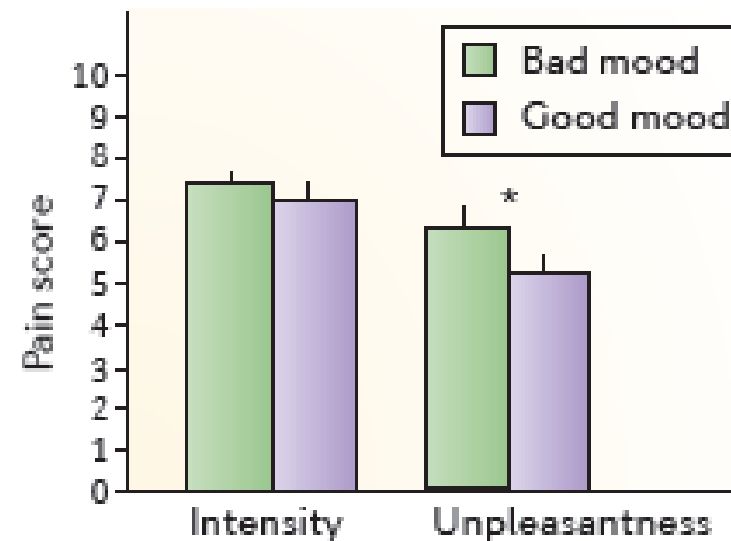
# Pain is Complex

- Context
- Meaning
- Cognition
- Emotion
- Affect
- Mood
- Attention
- Social factors

Attentional modulation



Emotional modulation







There's nothing I can  
do about my pain. It  
is only going to get  
worse!









# Descending Modulation





# **Perturbed connectivity of the amygdala and its subregions with the central executive and default mode networks in chronic pain**

Ying Jiang<sup>a,b</sup>, Desmond Oathes<sup>a,b</sup>, Julia Hush<sup>c</sup>, Beth Darnall<sup>d</sup>, Mylea Charvat<sup>a,b</sup>, Sean Mackey<sup>d</sup>, Amit Etkin<sup>a,b,\*</sup>

## **Abstract**

Maladaptive responses to pain-related distress, such as pain catastrophizing, amplify the impairments associated with chronic pain. Many of these aspects of chronic pain are similar to affective distress in clinical anxiety disorders. In light of the role of the amygdala in pain and affective distress, disruption of amygdalar functional connectivity in anxiety states, and its implication in the response to noxious stimuli, we investigated amygdala functional connectivity in 17 patients with chronic low back pain and 17 healthy comparison subjects, with respect to normal targets of amygdala subregions (basolateral vs centromedial nuclei), and connectivity to large-scale cognitive–emotional networks, including the default mode network, central executive network, and salience network. We found that

# Poor Descending Modulation of Pain

- Shapes neural functioning / patterns<sup>1</sup>
- Shapes the brain at “rest”<sup>2-3</sup>
- Sets the stage for prolonged symptoms, chronic pain<sup>3-4</sup>
- Primes the nervous system for pain<sup>5</sup>

1. Seminowicz and Davis. Cortical responses to pain in healthy individuals depends on pain catastrophizing (2014).
2. Kucyi et al. Enhanced medial prefrontal DMN functional connectivity in chronic pain and its association with pain rumination (2014).
3. Jiang, Oathes, Hush, **Darnall**, Charvat, Mackey, Etkin. Perturbed amygdalar connectivity with the Central Executive and Default Mode Networks in Chronic Pain (*PAIN*®, 2016).
4. Picavet et al. Pain catastrophizing and kinesiophobia: predictors of chronic low back pain (2002).
5. Taub, **Darnall**, Johnson, Mackey. Effects of a pain catastrophizing induction on quantitatively measured pain perception in women with chronic low back pain (2017).

# The biopsychosocial model of pain













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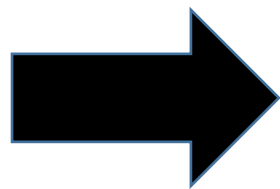


# Cognitive Behavioral Therapy for Chronic Pain

## Topics and Skills

- Pain and the brain
- Mood and pain
- Sleep and pain
- Pleasant activities
- Goal setting
- Problem solving
- Movement
- Social connection
- Diaphragmatic Breathing
- Relaxation Response
- Cognitive Restructuring
- Mindfulness
- Meditation







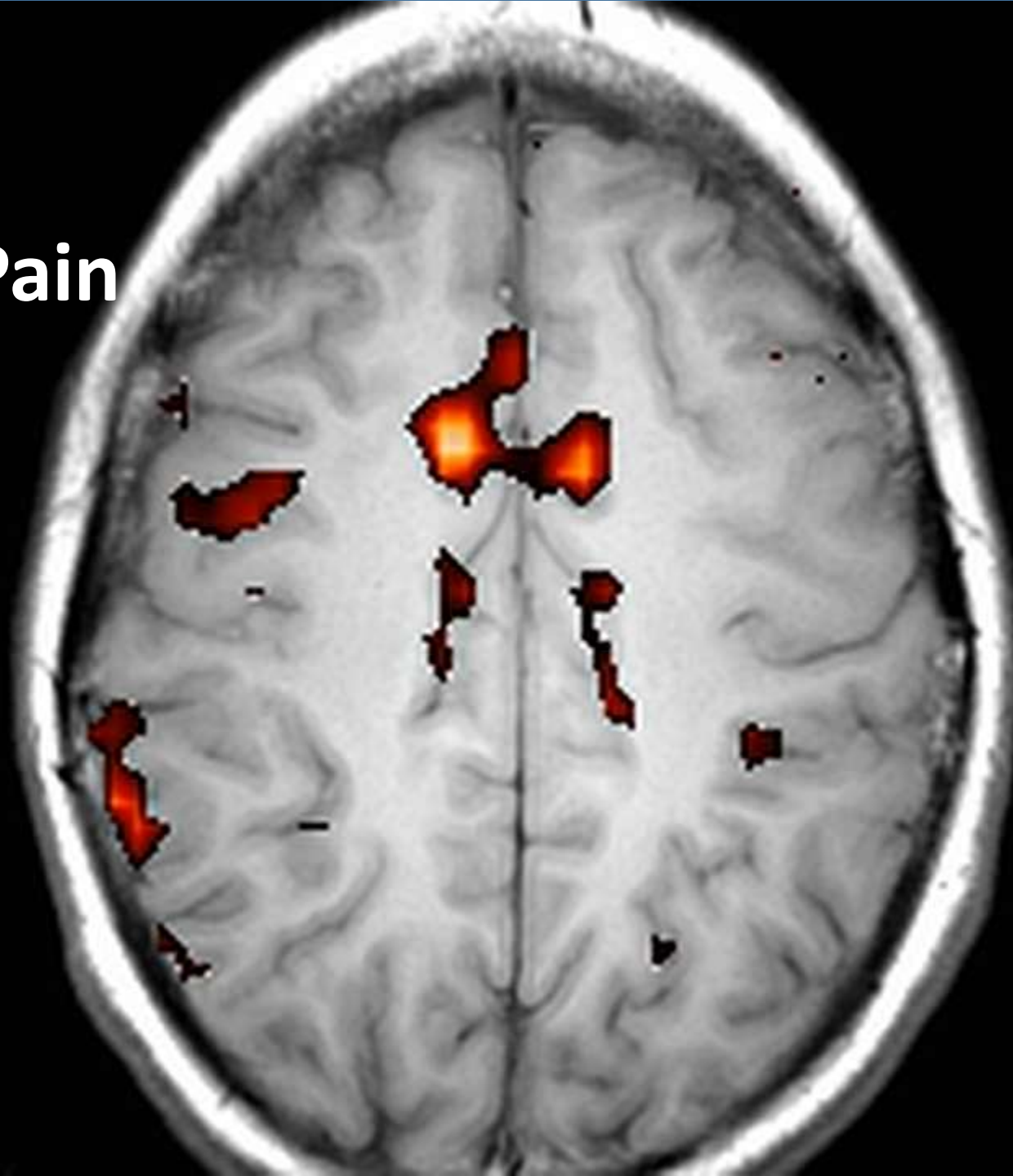
There are several things I can do right now to soothe myself and feel better.







**Unhelpful Pain  
Mindset**



**Pain Relief Skills**

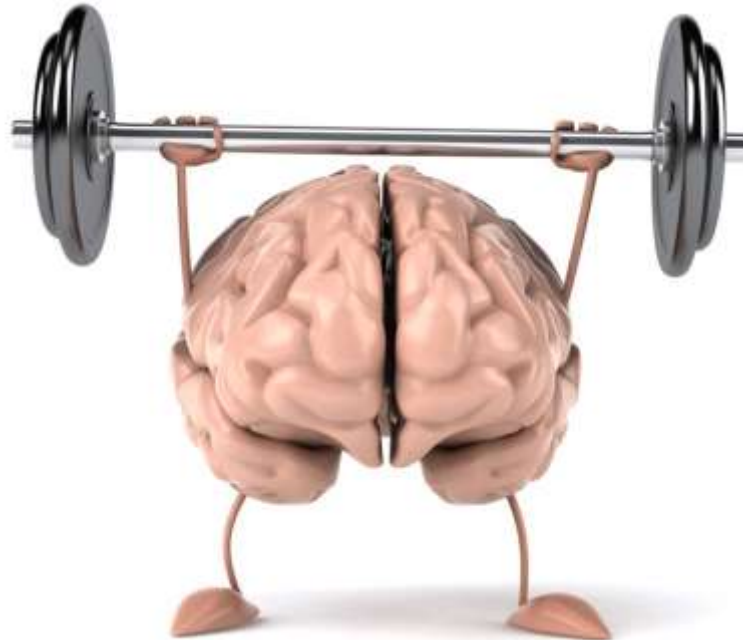
# Regular skills use:

- Dampens pain processing
- Reduces physiological hyperarousal
- Reduces cognitive and emotional responses that amplify pain
- Entrain positive neural patterns
- Facilitates movement, activation
- Increases self-efficacy, internal locus of control

# Pain Catastrophizing and Efficacy of Cognitive Behavioral Therapy

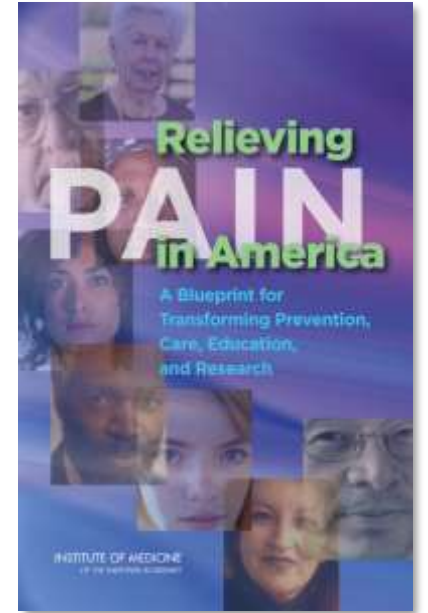
- Increases prefrontal gray matter in patients with chronic pain

Seminowicz DA, Shpaner M, Keaser ML, Krauthamer MG, Mantegna J, Dumas JA, Newhouse PA, Filippi C, Keefe FJ, Naylor MR. *J Pain*. 2013 Dec; 14(12):1573-84



# Behavioral Medicine for Pain Relief

- Institute of Medicine (2011)
- National Pain Strategy (2016)
- NASEM (2019)
- Center for Disease Control and Prevention (2019)
- HHS Interagency Task Force on Best Practices in Pain Management (2019)



Series

## Prevention and treatment of low back pain: evidence, challenges, and promising directions

Prof Nadine E Foster DPhil <sup>a</sup>  , Prof Johannes R Anema PhD <sup>b</sup>, Dan Cherkin PhD <sup>c</sup>, Prof Roger Chou PhD <sup>d</sup>, Prof Steven P Cohen MD <sup>e, f</sup>, Prof Douglas P Gross PhD <sup>g</sup>, Paulo H Ferreira PhD <sup>h</sup>, Prof Julie M Fritz PhD <sup>i</sup>, Prof Bart W Koes PhD <sup>j</sup>, Prof Wilco Peul PhD <sup>k</sup>, Prof Judith A Turner PhD <sup>l</sup>, Prof Chris G Maher PhD <sup>m</sup>  
Lancet Low Back Pain Series Working Group<sup>†</sup>

Education: First-line treatment  
CBT: First-line treatment





- Insurance coverage
- Time
- Co-pays
- Travel
- Work / family obligations
- Pain / health
- Proximity (rural settings)
- No psychologists nearby who are trained to treat pain

# **Pain Psychology: A Global Needs Assessment and National Call to Action**

**Beth D. Darnall, PhD,<sup>\*,a</sup> Judith Scheman, PhD,<sup>†,a</sup>  
Sara Davin, PhD,<sup>†,b</sup> John W. Burns, PhD,<sup>‡,b</sup>  
Jennifer L. Murphy, PhD,<sup>§,b</sup> Anna C. Wilson, PhD,<sup>¶,b</sup>  
Robert D. Kerns, PhD,<sup>||</sup> and  
Sean C. Mackey, MD, PhD,<sup>\*,a</sup>**

<sup>\*</sup>Stanford University School of Medicine, Department of Anesthesiology, Perioperative and Pain Medicine, Division of Pain Medicine, Stanford Systems Neuroscience and Pain Laboratory, Palo Alto, California; <sup>†</sup>Center for Neurological Restoration, Cleveland Clinic, Cleveland, Ohio; <sup>‡</sup>Department of Behavioral Sciences, Rush University, Chicago, Illinois; <sup>§</sup>Chronic Pain Rehabilitation Program, James A. Haley Veterans' Hospital, Tampa, Florida; <sup>¶</sup>Institute on Development & Disability, IDD Division of

**Design.** Prospective, observational, cross-sectional.

**Methods.** Brief surveys were administered online to six stakeholder groups (psychologists/therapists, individuals with chronic pain, pain physicians, primary care physicians/physician assistants, nurse practitioners, and the directors of graduate and postgraduate psychology training programs).

**Results.** 1,991 responses were received. Results revealed low confidence and low perceived competency to address physical pain among psychologists/therapists, and high levels of interest and need for pain education. We found broad support for pain psychology across stakeholder groups, and global support for a national initiative to increase pain training and competency in U.S. therapists. Among dir-

# Addressing Pain Care Disparities with Accessible Solutions

- Meet patients where they are
- Convenient
- Brief
- Include the family
- Home-based
- Leverage technology

# An evidence-based, single-session pain class that rapidly equips patients with pain management skills

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For patients with acute and chronic pain and their families





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M E D I C I N E



National Center for  
Complementary and  
Integrative Health



National Institute  
on Drug Abuse

- Developed at Stanford University
- Funded by multiple NIH institutes
- Delivered throughout the U.S. and internationally
- Two randomized efficacy trials – published results



# From Catastrophizing to Recovery: a pilot study of a single-session treatment for pain catastrophizing

This article was published in the following Dove Press journal:

Journal of Pain Research

25 April 2014

Number of times this article has been viewed



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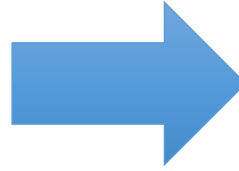
Beth D Darnall  
John A Sturgeon  
Ming-Chih Kao  
Jennifer M Hah  
Sean C Mackey

Division of Pain Medicine,  
Stanford Systems Neuroscience  
and Pain Laboratory, Stanford  
University School of Medicine,  
Palo Alto, CA, USA

**Background:** Pain catastrophizing (PC) – a pattern of negative cognitive-emotional responses to real or anticipated pain – maintains chronic pain and undermines medical treatments. Standard PC treatment involves multiple sessions of cognitive behavioral therapy. To provide efficient treatment, we developed a single-session, 2-hour class that solely treats PC entitled “From Catastrophizing to Recovery” [FCR].

**Objectives:** To determine 1) feasibility of FCR; 2) participant ratings for acceptability, understandability, satisfaction, and likelihood to use the information learned; and 3) preliminary efficacy of FCR for reducing PC.

**Design and methods:** Uncontrolled prospective pilot trial with a retrospective chart and



From: Darnall BD. The Opioid-Free Pain Relief Kit © 2016. Bull Publishing

# Single-Session Skills-Based Class Reduces Catastrophizing

Time Point	PCS Mean (SD)
Baseline	26.1 (10.8)
Post-Treatment Week 2	16.5 (9.9)
Post-Treatment Week 4	13.8 (9.5)

N=57

PCS = Pain Catastrophizing Scale

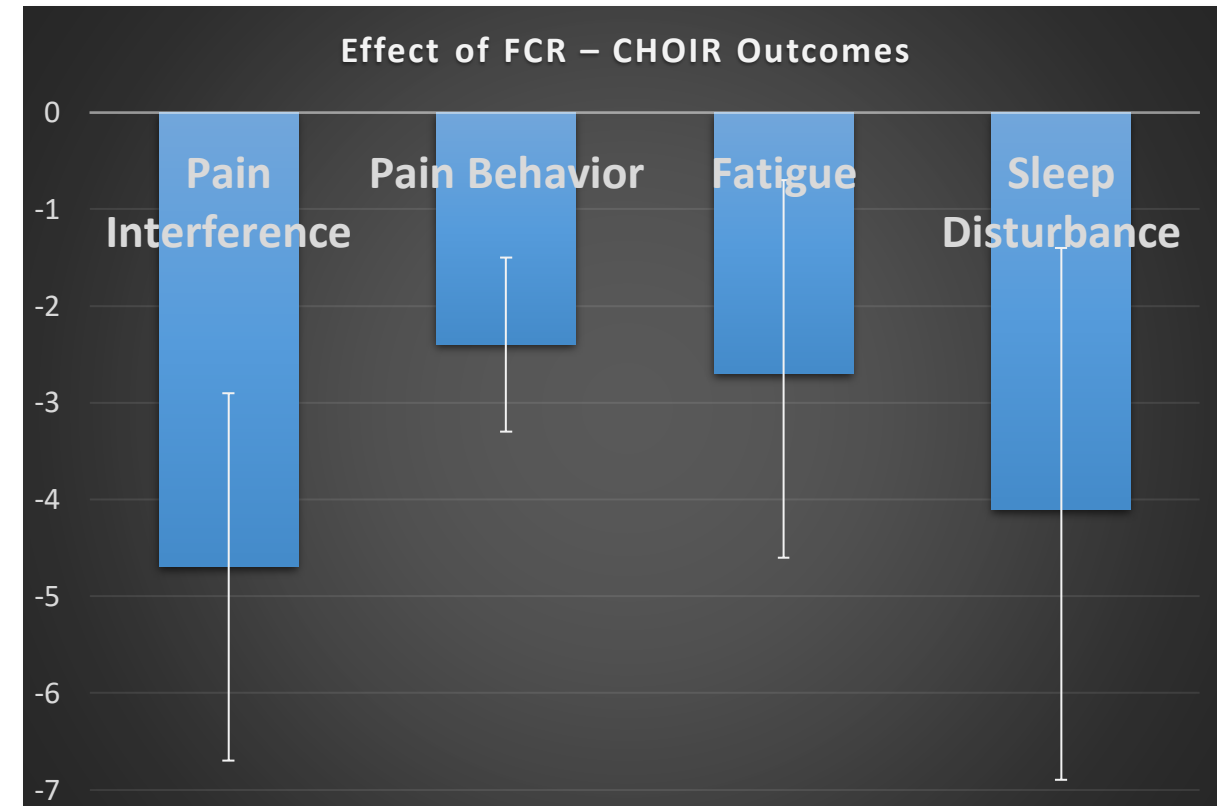


# Single-session skills-based pain class

N = 57

Time Point	PCS Mean (SD)
Baseline	26.1 (10.8)
Post-Treatment Week 2	16.5 (9.9)
Post-Treatment Week 4	13.8 (9.5)

Baseline to Post-Treatment Week 4:  $d = 1.15$



# Clinical importance of post-class PCS changes

	Week 2		Week 4	
	N	PCS Change	N	PCS Change
Increased PCS	5	+19.8 (21.6)%	3	+41.3 (21.6)%
No Change (<15%)	15	-1.2 (2.8)%	5	-6.5 (2.7)%
Minimally Important Change (15-29%)	10	-23.3 (3.2)%	12	-22.4 (4.5)%
Moderately Important Change (30-49%)	13	-40.6 (4.9)%	16	-38.4 (4.7)%
Substantially Important (≥50%)	14	-61.3 (11.9)%	21	-67.2 (12.3)%

N = 263

Health Education

8-week CBT



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Original Investigation | Physical Medicine and Rehabilitation

# Comparison of a Single-Session Pain Management Skills Intervention With a Single-Session Health Education Intervention and 8 Sessions of Cognitive Behavioral Therapy in Adults With Chronic Low Back Pain

## A Randomized Clinical Trial

Beth D. Darnall, PhD; Anuradha Roy, MSc; Abby L. Chen, BS; Maisa S. Ziadni, PhD; Ryan T. Keane, MA; Dokyoung S. You, PhD; Kristen Slater, PsyD; Heather Poupore-King, PhD; Ian Mackey, BA; Ming-Chih Kao, PhD, MD; Karon F. Cook, PhD; Kate Lorig, DrPH; Dongxue Zhang, MS; Juliette Hong, MS, MEd; Lu Tian, PhD; Sean C. Mackey, MD, PhD

### Abstract

**IMPORTANCE** Chronic low back pain (CLBP), the most prevalent chronic pain condition, imparts substantial disability and discomfort. Cognitive behavioral therapy (CBT) reduces the effect of CLBP, but access is limited.

**OBJECTIVE** To determine whether a single class in evidence-based pain management skills (empowered relief) is noninferior to 8-session CBT and superior to health education at 3 months after treatment for improving pain catastrophizing, pain intensity, pain interference, and other secondary outcomes.

**DESIGN, SETTING, AND PARTICIPANTS** This 3-arm randomized clinical trial collected data from May 24, 2017, to March 3, 2020. Participants included individuals in the community with self-reported CLBP for 6 months or more and an average pain intensity of at least 4 (range, 0-10, with 10 indicating worst pain imaginable). Data were analyzed using intention-to-treat and per-protocol approaches.

**INTERVENTIONS** Participants were randomized to (1) empowered relief, (2) health education

### Key Points

**Question** Is a single-session pain relief class noninferior to 8 sessions of cognitive behavioral therapy (CBT) at 3 months after treatment?

**Findings** In this 3-arm randomized clinical trial that included 263 adults with chronic low back pain, a single-session pain management skills class was noninferior to 8 weeks of CBT and superior to a health education class for pain catastrophizing and multiple secondary outcomes at 3 months after treatment.

**Meaning** For patients with chronic low back pain, a single-session pain relief skills class showed comparable efficacy





**Empowered Relief™** was similar  
to 8-session CBT for improving:

- Pain intensity
- Pain interference
- Pain catastrophizing

Secondary outcomes:

- Pain self-efficacy
- Pain bothersomeness
- Sleep disturbance
- Depression
- Anxiety
- Fatigue

Study Details:

- Chronic low back pain study (N=263)
- Half had 2+ chronic pain conditions
- ***Results at 3 months post-treatment***



Darnall BD et al. JAMA Network Open. AUG 2021;4(8):e2113401.

Cited by the 2019 HHS Best Practices Pain Management  
Task Force as a promising and scalable treatment option





Original Paper

# Efficacy of a Single-Session “Empowered Relief” Zoom-Delivered Group Intervention for Chronic Pain: Randomized Controlled Trial Conducted During the COVID-19 Pandemic

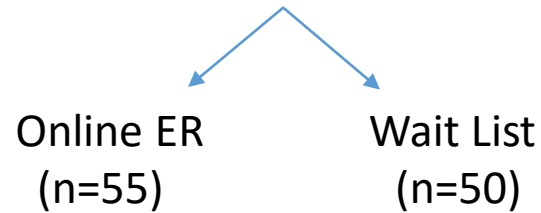
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Maisa S Ziadni<sup>1</sup>, MS, PhD; Lluvia Gonzalez-Castro<sup>1</sup>, BS; Steven Anderson<sup>1</sup>, PhD; Parthasarathy Krishnamurthy<sup>2</sup>, PhD; Beth D Darnall<sup>1</sup>, PhD

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# Online ER Study

Randomized Controlled Study (N=105)



- No in-person visits
- Occurred during COVID
- Enrolled 100 people in first 11 days
- Mixed etiology chronic pain
- Follow-up at 3 months post-treatment

Ziadni MS, Anderson SR, Gonzalez-Castro L, Krishnamurthy P, Darnall BD. Efficacy of a Single-Session "Empowered Relief" Zoom-Delivered Group Intervention for Chronic Pain: Randomized Controlled Trial Conducted During COVID-19. (*JMIR*. 2021. Vol 23, No 9 (2021): September)

# Between group results at 3 months

Variable	Time (Months)	ER Mean (SE)	Wait List Mean (SE)	Difference Mean (SE)	p-value	95% CI*	Effect Size*
Pain Catastrophizing	0	20.64 (1.53)	20.22 (1.52)	0.42 (2.16)	0.844	-3.81 — 4.66	0.04
Pain Catastrophizing	3	11.92 (1.39)	17.97 (1.39)	-6.05 (1.97)	0.0023	-9.92 — -2.18	0.62
Anxiety (PROMIS)	0	59.57 (1.23)	60.41 (1.22)	-0.84 (1.73)	0.6263	-4.24 — 2.56	0.10
Anxiety (PROMIS)	3	54.85 (1.28)	59.99 (1.28)	-5.14 (1.81)	0.0048	-8.7 — -1.58	0.57
Pain Intensity (PROMIS)	0	62.24 (0.98)	62.53 (0.97)	-0.28 (1.39)	0.8379	-3.01 — 2.44	0.04
Pain Intensity (PROMIS)	3	57.26 (1.18)	61.07 (1.2)	-3.81 (1.68)	0.0245	-7.12 — -0.49	0.45
Pain Bothersomeness	0	5.78 (0.29)	6.3 (0.29)	-0.52 (0.4)	0.198	-1.31 — 0.27	0.26
Pain Bothersomeness	3	4.62 (0.35)	5.92 (0.36)	-1.3 (0.5)	0.0102	-2.29 — -0.31	0.52
Anger (PROMIS)	0	54.64 (1.57)	55.48 (1.57)	-0.84 (2.22)	0.7054	-5.21 — 3.53	0.08
Anger (PROMIS)	3	50.54 (1.33)	56 (1.35)	-5.47 (1.89)	0.0041	-9.19 — -1.75	0.58
Sleep Disturbance (PROMIS)	0	56.28 (1.25)	59.5 (1.25)	-3.22 (1.77)	0.0694	-6.69 — 0.26	0.37
Sleep Disturbance (PROMIS)	3	53.46 (1.38)	61.19 (1.4)	-7.74 (1.97)	0.0001	-11.61 — -3.87	0.79

\*between group

N/S: Depression, Pain Interference, Social Isolation



# Certification Workshops for Healthcare Clinicians



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Dr. Maisa Ziadni



National Institute  
on Drug Abuse



RCT of Empowered Relief in people with chronic pain taking daily prescription opioids

## Stanford Pain Relief Innovations Lab



National Institute  
on Drug Abuse

RCT of “Empowered Relief: On Demand” an app-based version that is tailored to people with opioid misuse or OUD





Meta-analysis 15 studies (N = 5046):

PC best predicts postsurgical chronic pain

Theunissen M et al. *Clin J Pain* 2012

PC best predicts prolonged opioid use after surgery

Helmerhorst GTT et al. *J Bone & Joint Surg* 2014.







## Welcome to *My Surgical Success*®!

We are very excited to present you our pain psychology package called My Surgical Success®. My Surgical Success® provides you with education and specific mind-body skills to use in order to prepare for your surgery. We hope to teach you to better control pain and distress without additional medication; Research shows that regular use of these skills helps with healing after surgery. We aim to get you on the road to recovery, and back to doing the things you love as quickly as possible!

Step 1:  
Print personal plan

Step 2:  
Watch video &  
complete personal plan

Step 3:  
Click to download audio

Step 4:  
Tell us what you think!

### My Surgical Success

Mind – Body Medicine for Health &

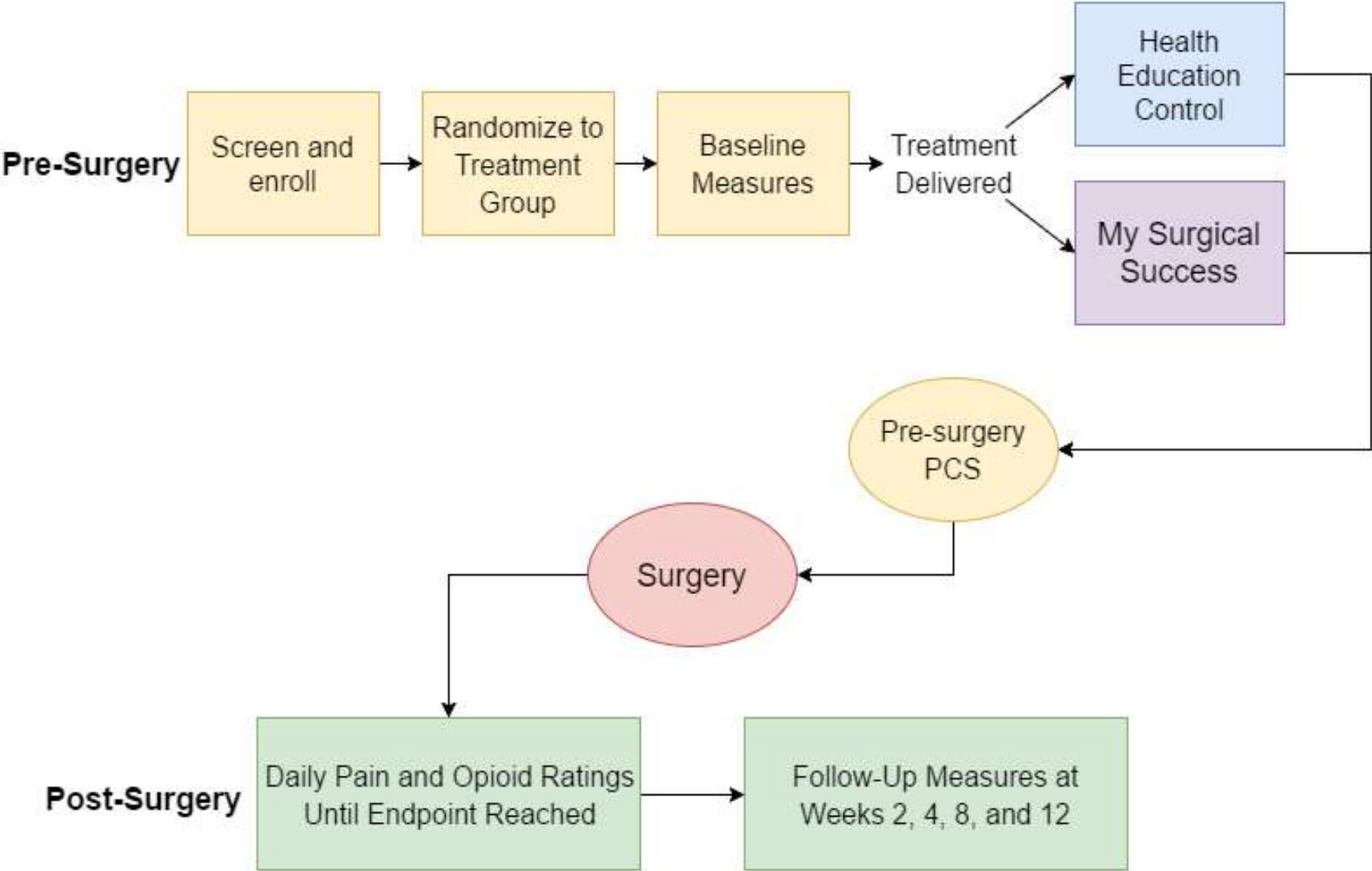
Beth Darnall, PhD

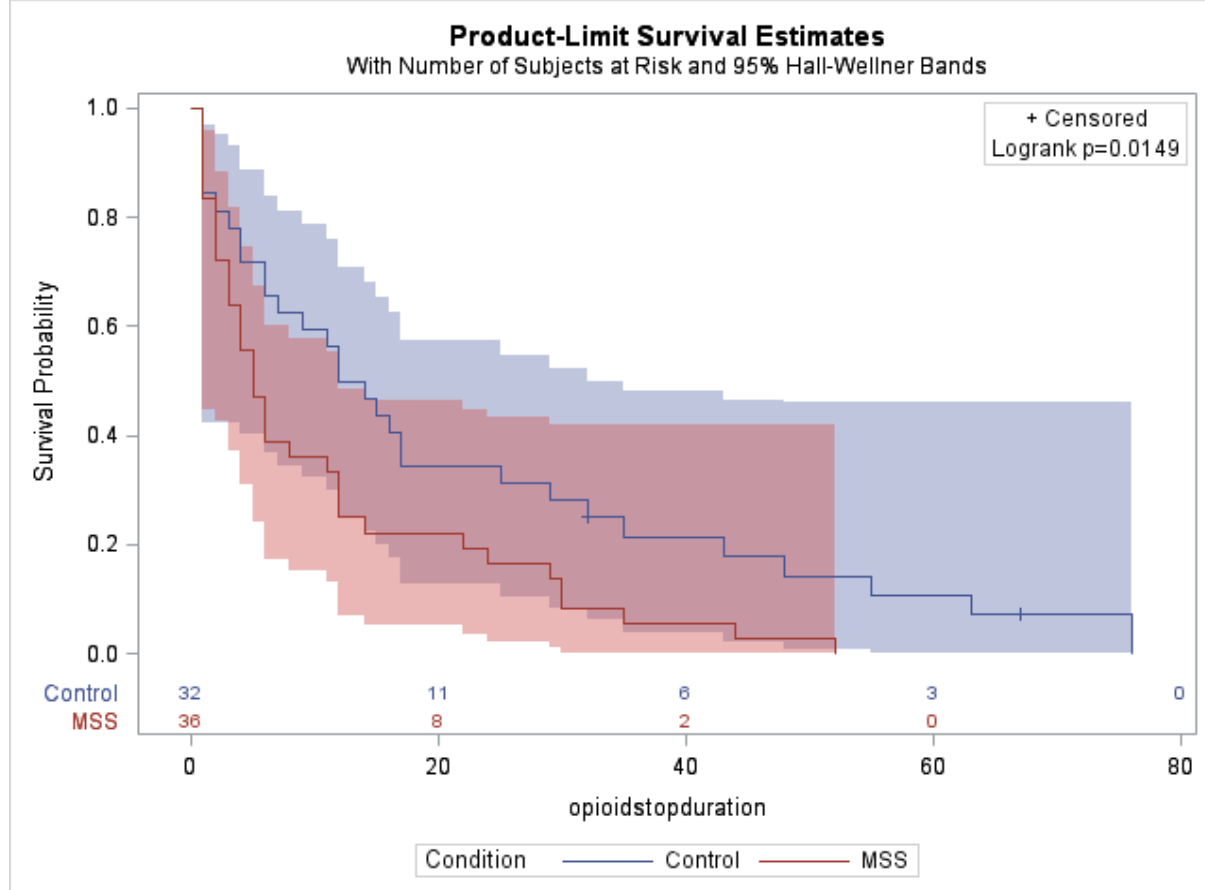
Clinical Professor  
Stanford University  
Anesthesiology, Perioperative, and Pain  
Division of Pain Medicine  
Stanford Systems Neuroscience & Pain



And welcome to My  
Surgical Success.

**Darnall BD**, Ziadni MS, Krishnamurthy P, Mackey IG, Heathcote L, Taub CJ, Flood P, Wheeler A.  
“My Surgical Success”: Impact of a digital behavioral pain medicine intervention on time to opioid cessation after breast cancer surgery (May 2019, *Pain Med*).





N = 68 (MSS, n = 36; HE, n = 32)

## Effects of My Surgical Success (MSS) vs HE Control in Unadjusted and Adjusted Model on Opioid Cessation

Model	Effect	HR Estimate	Lower 95% CI	Upper 95% CI	z Value	Pr >  z
Unadjusted Model						
	MSS versus HE	1.8623	1.1205	3.0952	2.40	0.0164
Adjusted Model						
	MSS versus HE	1.7405	1.0276	2.9478	2.06	0.0393
	PROMIS Anger	0.9734	0.9374	1.0107	-1.4	0.1601
	PROMIS Fatigue	1.0081	0.9749	1.0426	0.47	0.6357
	PROMIS Physical	0.998	0.9575	1.0403	-0.09	0.9256



# Spine Surgery



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MEDICINE



Department of Orthopaedic Surgery



# Behavioral Pain Medicine: Who needs it?



RESEARCH ARTICLE

# Virtual reality for management of pain in hospitalized patients: A randomized comparative effectiveness trial

Brennan Spiegel<sup>1,2\*</sup>, Garth Fuller<sup>1</sup>, Mayra Lopez<sup>1</sup>, Taylor Dupuy<sup>1</sup>, Benjamin Noah<sup>1</sup>, Amber Howard<sup>1</sup>, Michael Albert<sup>1</sup>, Vartan Tashjian<sup>1</sup>, Richard Lam<sup>1</sup>, Joseph Ahn<sup>1</sup>, Francis Dailey<sup>1</sup>, Bradley T. Rosen<sup>1,3</sup>, Mark Vrahas<sup>4</sup>, Milton Little<sup>4</sup>, John Garlich<sup>4</sup>, Eldin Dzibur<sup>1</sup>, Waguhi IsHak<sup>5</sup>, Itai Danovitch<sup>5</sup>

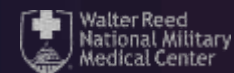
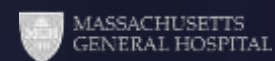
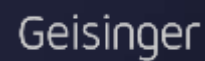
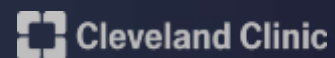


DOI:10.1371/journal.pone.0172000





52%  
Pain Reduction





Home-based VR  
for chronic pain



Darnall BD, Krishnamurthy P, Tsui J, Minor JG. Self-Administered Skills-Based Virtual Reality Intervention for Chronic Pain: A Randomized Controlled Pilot Study. *JMIR Formative Research*. 2020; 4(7): July.





Original Paper

# An 8-Week Self-Administered At-Home Behavioral Skills-Based Virtual Reality Program for Chronic Low Back Pain: Double-Blind, Randomized, Placebo-Controlled Trial Conducted During COVID-19

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Laura M Garcia<sup>1</sup>, PhD; Brandon J Birckhead<sup>1</sup>, MD, MHDS; Parthasarathy Krishnamurthy<sup>2</sup>, MBA, PhD; Josh Sackman<sup>1</sup>, MBA; Ian G Mackey<sup>1</sup>, BA; Robert G Louis<sup>3</sup>, MD; Vafi Salmasi<sup>4</sup>, MD, MSc; Todd Maddox<sup>1</sup>, PhD; Beth D Darnall<sup>4</sup>, PhD

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<sup>2</sup>CT Bauer College of Business, University of Houston, Houston, TX, United States

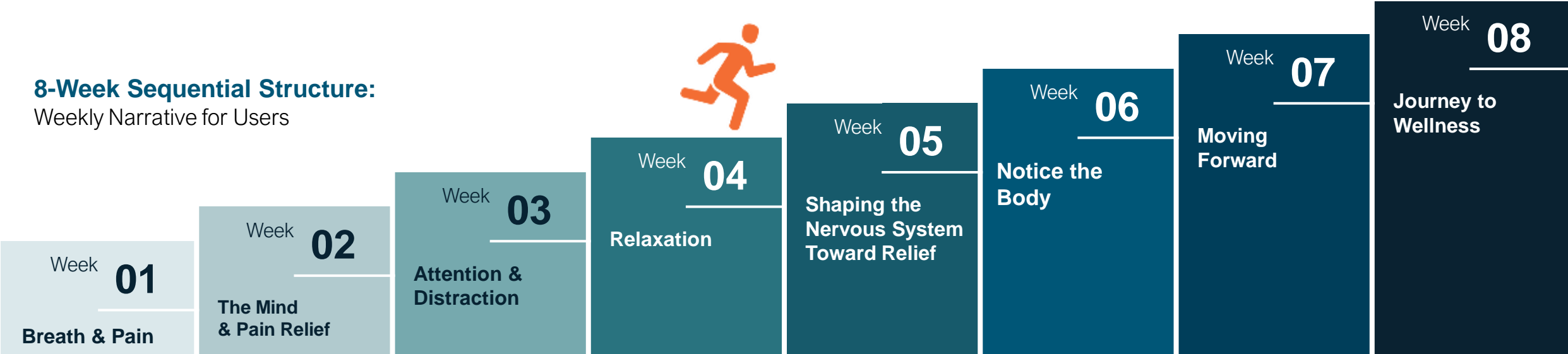
<sup>3</sup>Division of Neurosurgery, Pickup Family Neurosciences Institute, Hoag Memorial Hospital, Newport Beach, CA, United States

<sup>4</sup>Department of Anesthesiology, Perioperative and Pain Medicine, Stanford University School of Medicine, Palo Alto, CA, United States

# The EaseVRx Program

EaseVRx is an eight-week program which teaches the participant how to recognize and adjust cognitive, emotional, and physical responses to chronic pain. **Dosage:** 1 session per day (avg duration: 7 mins) x 56 days

## 8-Week Sequential Structure: Weekly Narrative for Users



## Content Categories



Breathing-Based Biofeedback



Pain Education



Pain Distraction



Relaxation / Interoception



Mindful Escapes

# Randomized, placebo-controlled trial in chronic low back pain

- **N = 179; Inclusion:** 18-81 years of age; self-reported CLBP  $\geq$  6 months duration and past month pain intensity  $> 4/10$
- **Recruitment:** Online recruitment; **Blinding:** Participants and analysts; **Randomization:** 1:1; no blocking applied



**EaseVRx** (n=94): Multimodal, skills-based, pain relief VR program (56 sessions - 1 per day)



**Sham VR** (n=94): Non-immersive, non-interactive 2D nature footage & neutral music (56 sessions - 1 per day)







# Program Adherence

Participants were highly engaged, completing 77% or more of EaseVRx and Sham VR programs

On average, EaseVRx participants completed 5.4 sessions per week; Sham VR participants completed 6.0 session per week.

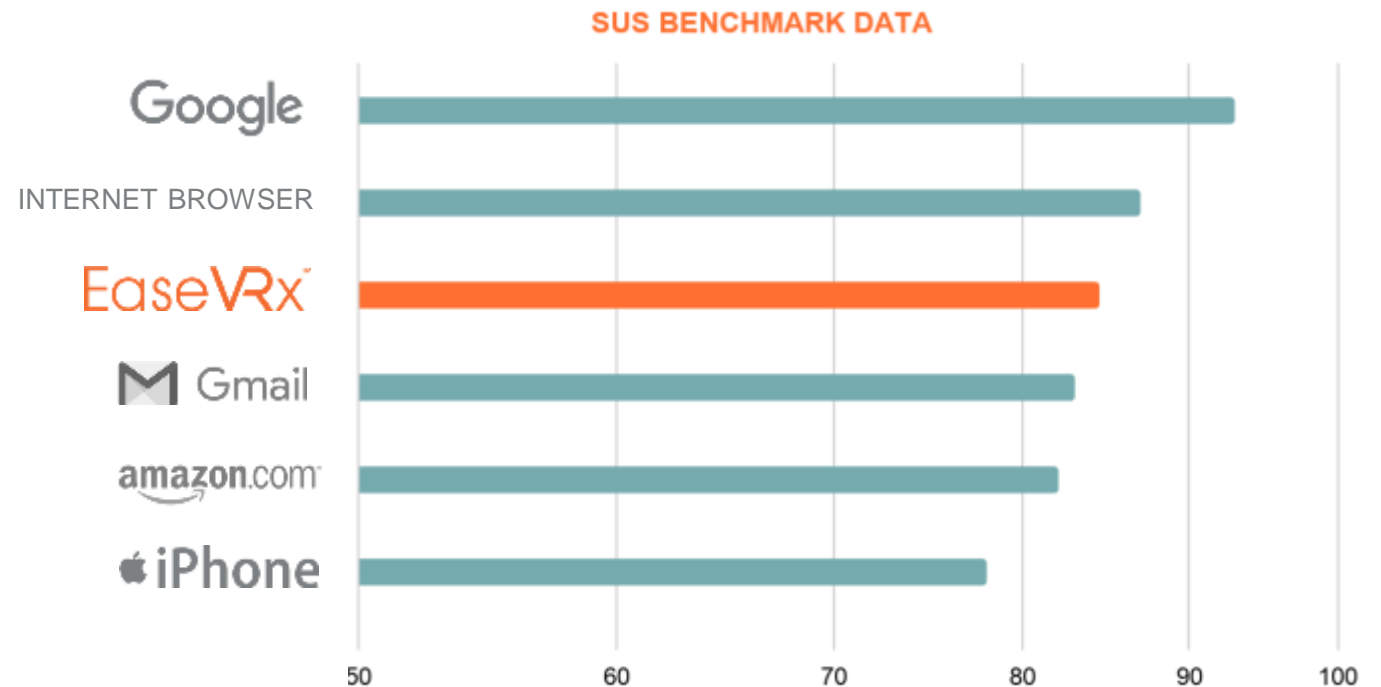
*\*Based on devices that have been returned and/or connected to wifi*

<b>n=149*</b>	<b># Experiences</b>
EaseVRx (N=77)	43.30
Sham VR (n=72)	48.06
p	0.17

# Usability Ratings

- Participants rated high usability for both interventions, which leveraged the same software interface.
- EaseVRx was rated 84.33 on the System Usability Scale which is considered an A+ in usability according to industry benchmarks
- There was no statistical significance between groups

		SUS
EaseVRx	mean	84.33
Sham VR	mean	81.16
p value		0.24
Effect Size EaseVRx vs. Sham VR		0.22

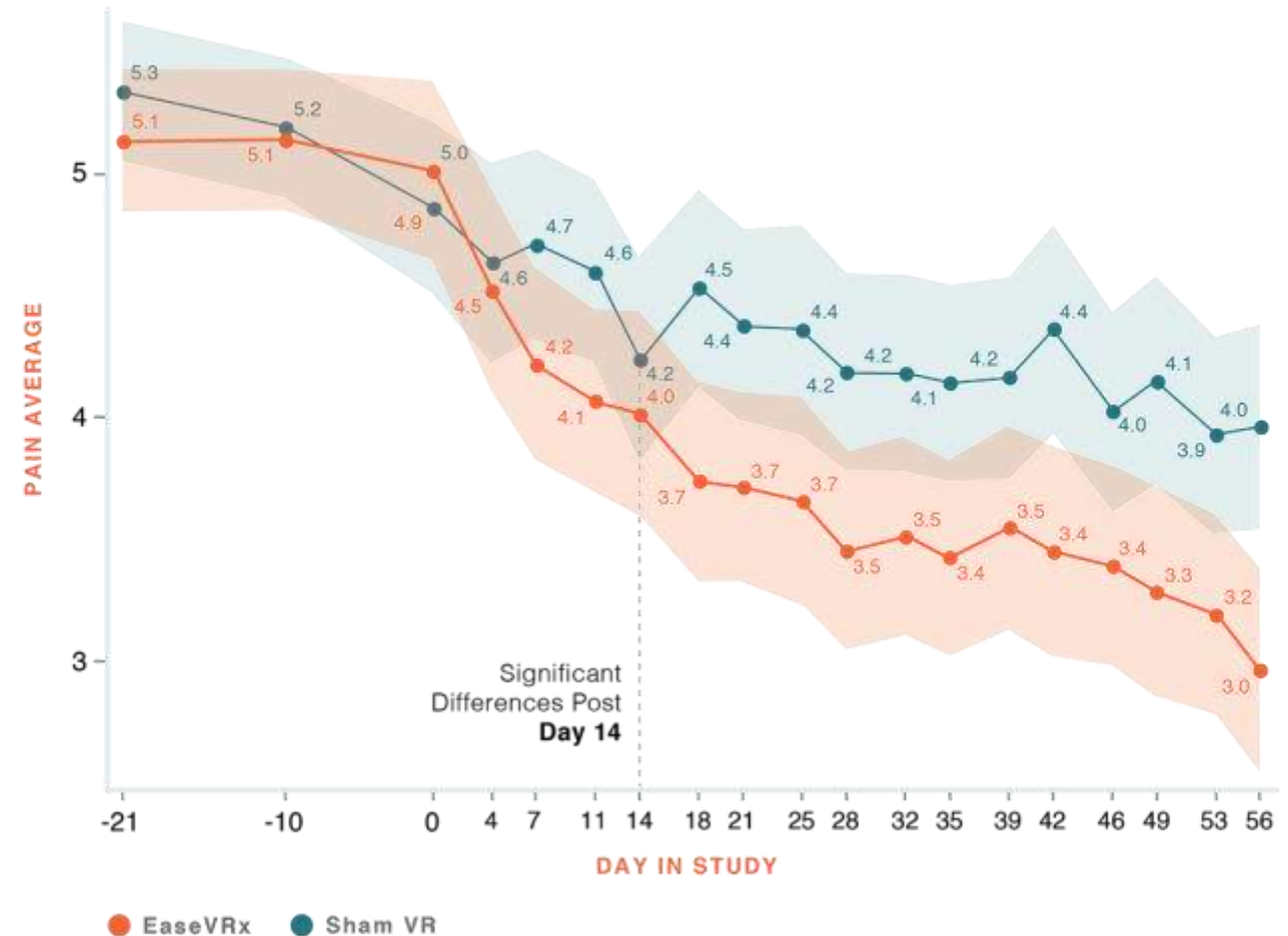


Efficacy:

# Pain Intensity

- Clinically meaningful percentage change on average pain intensity from baseline to post-treatment for both groups (-41% EaseVRx vs. -23% Sham VR)
- Between group difference was significant ( $p = 0.0006$ )

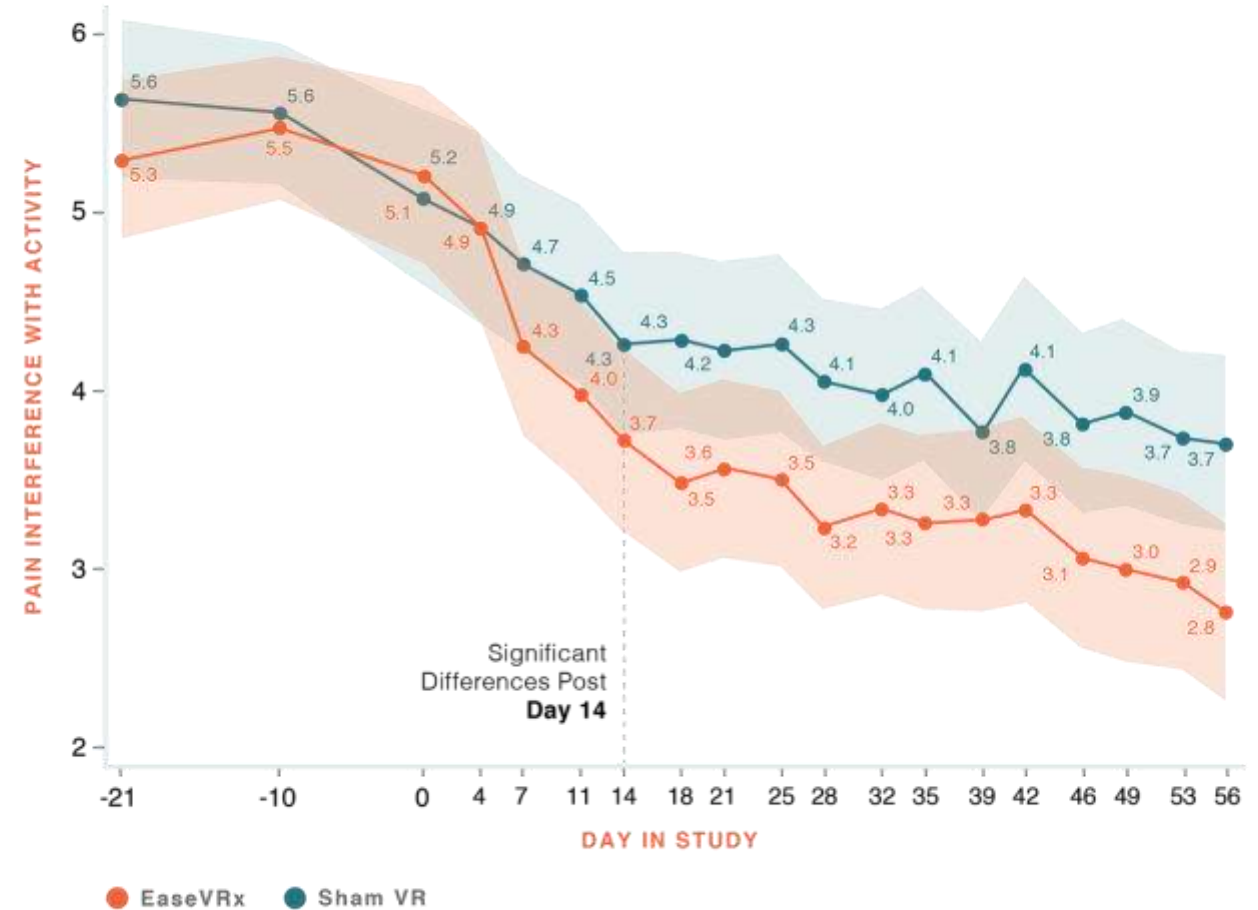
In the past 24 hours,  
how would you rate your pain on AVERAGE?



# Pain Interference with Activity

- Clinically meaningful percentage change on activity interference from baseline to post-treatment for both groups (-48% EaseVRx vs. -32% Sham VR)
- Between group difference was significant ( $p = 0.008$ )

Select the number that describes how, during the past 24 hours, pain has interfered with your ACTIVITY.

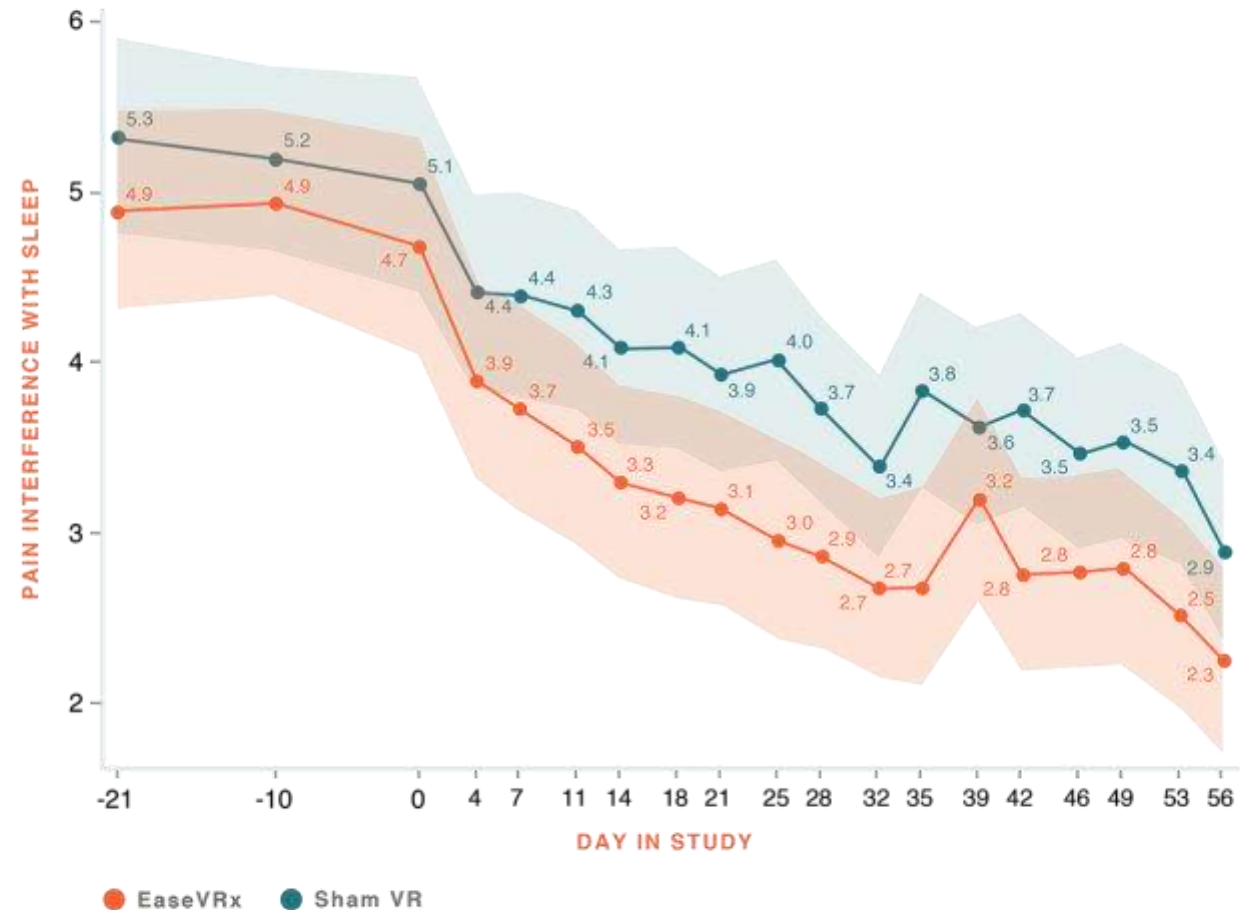




# Pain Interference with Sleep

- Clinically meaningful percentage change on activity interference from baseline to post-treatment for both groups (-51% EaseVRx vs. -38% Sham VR)
- Between group difference was not significant ( $p = 0.2$ )

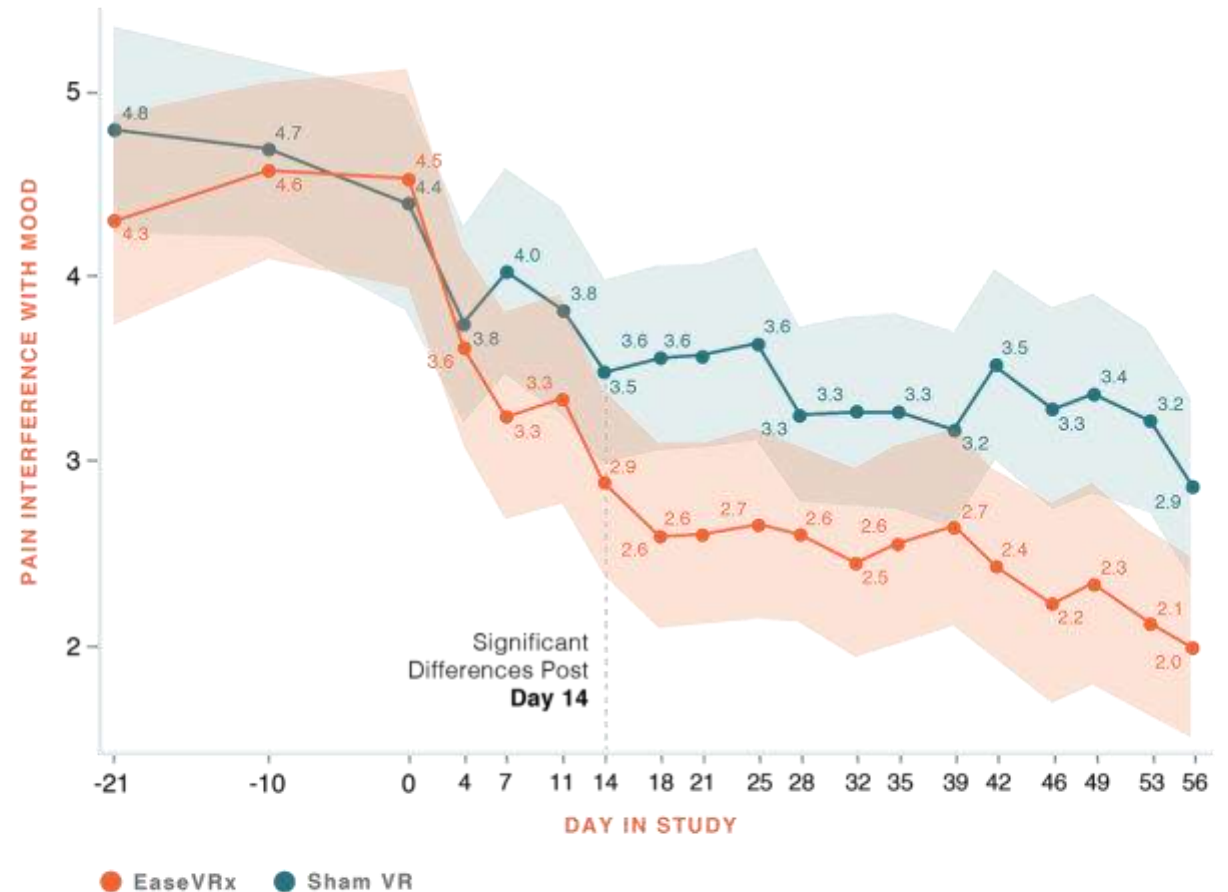
Select the number that describes how, during the past 24 hours, pain has interfered with your SLEEP.



# Pain Interference with Mood

Select the number that describes how, during the past 24 hours, pain has interfered with your MOOD.

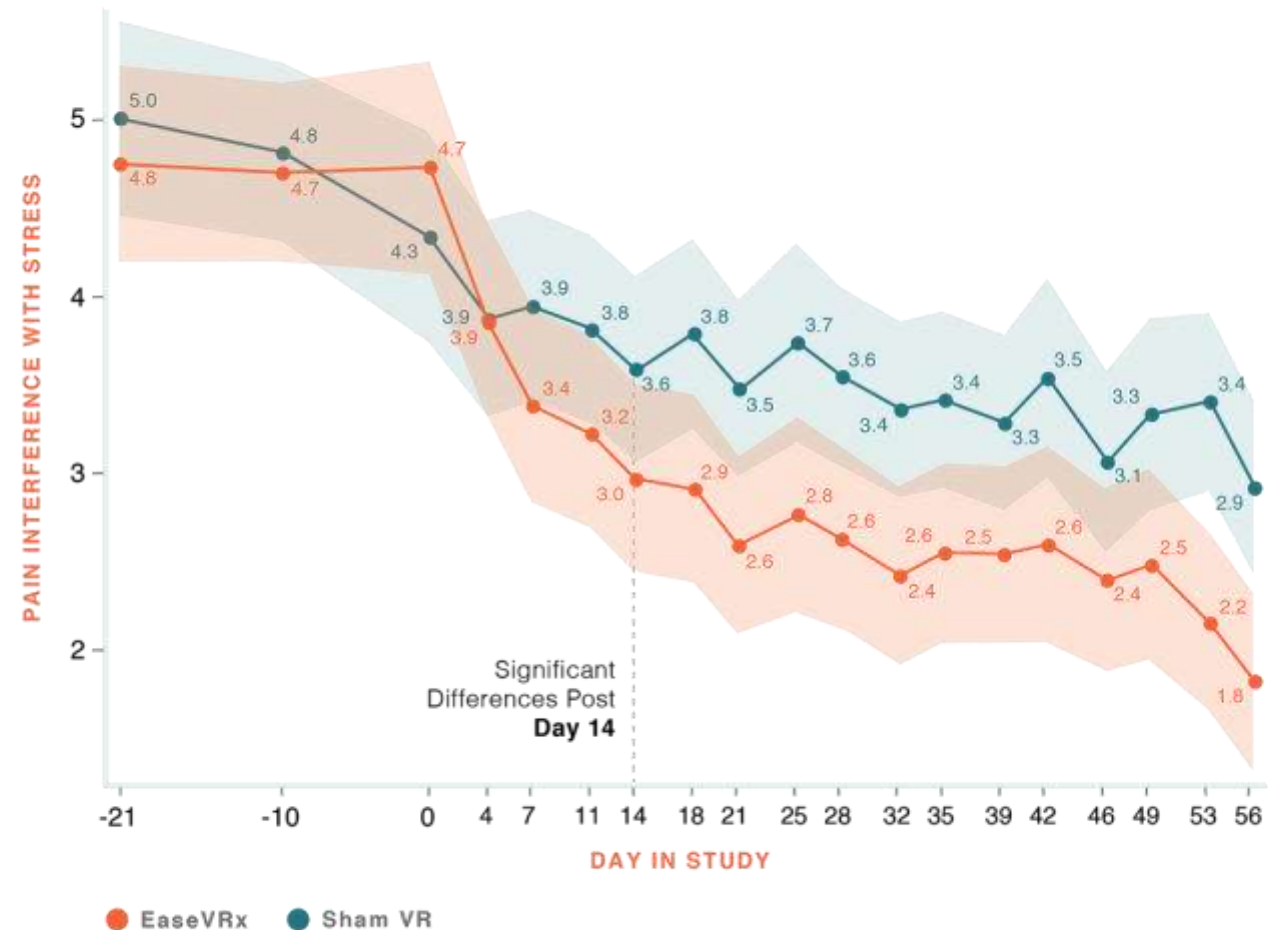
- Clinically meaningful percentage change on mood interference from baseline to post-treatment for both groups (-55% EaseVRx vs. -37% Sham VR)
- Between group difference was significant ( $p = 0.033$ )



# Pain Interference with Stress

- Clinically meaningful percentage change on stress interference from baseline to post-treatment for both groups (-57% EaseVRx vs. -37% Sham VR)
- Between group difference was significant ( $p = 0.025$ )

Select the number that describes how, during the past 24 hours, pain has interfered with your STRESS.



# Summary of Primary Endpoints

- EaseVRx demonstrated clinically meaningful outcomes ( $\geq 30\%$  change from baseline to post) across each primary endpoint, with large within-group effect size.
- **% Change from Baseline to Post (per protocol analyses)**

	Pain	Activity	Sleep	Mood	Stress
EaseVRx (n=84)	-41.6	-48.9	-51.7	-55.7	-57.0
ShamVR (n=84)	-23.5	-32.1	-38.1	-36.9	-37.4
between group p	<.001	.006	.2	.03	.02
EaseVRx Effect Size (baseline:post)	1.3	1.3	0.95	1.19	1.2

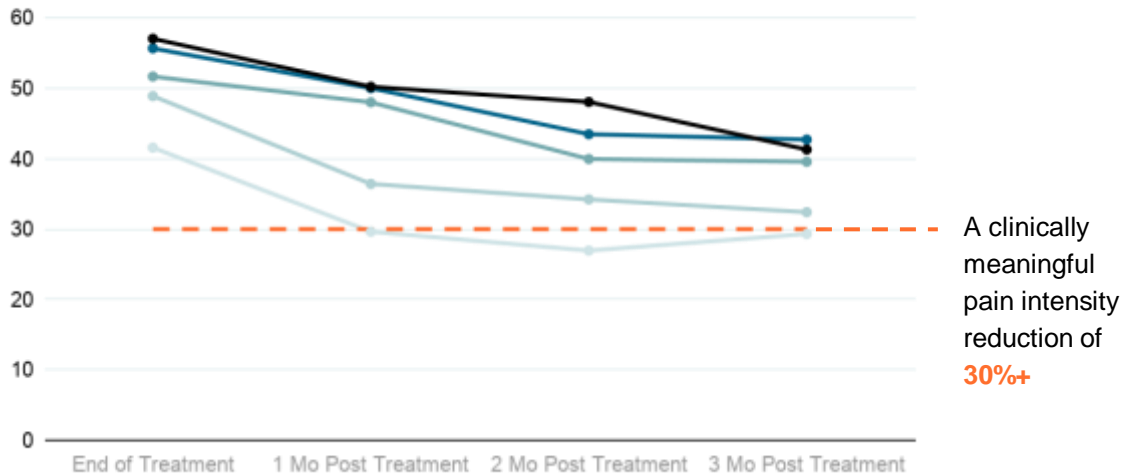


# Durability of Effects at 3 months post-treatment

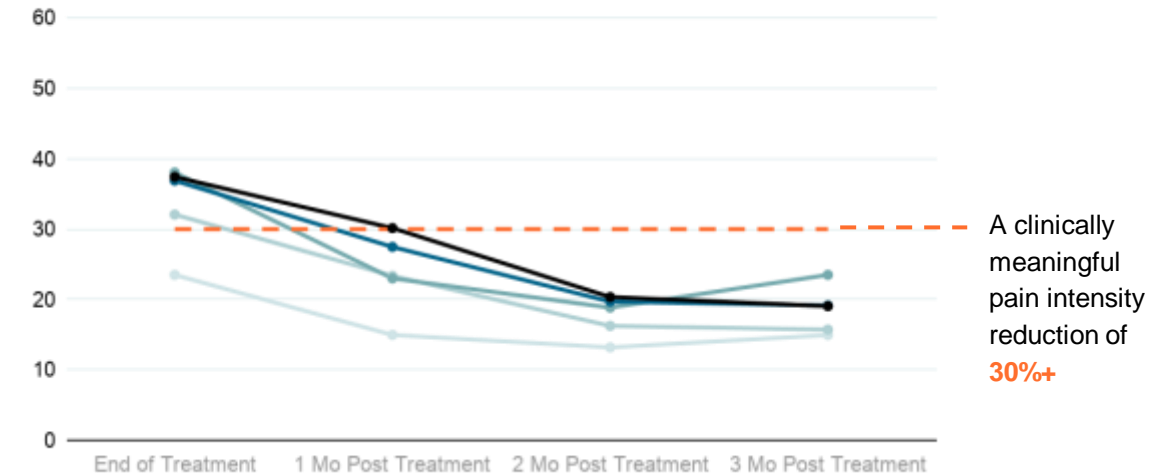
Percent Pain Reduction from Pre-Treatment to End of Treatment, 1 month follow-up, 2 month follow-up and 3 month follow-up Post Treatment

- Stress
- Mood
- Sleep
- Activity
- Intensity

## EaseVRx™



## Sham VR



Garcia L, Birckhead B, Krishnamurthy P, Sackman J, Mackey IG, Louis R, Salmasi V, Maddox WT, Darnall BD. Double-blind, randomized, placebo-controlled trial of 8-week self-administered at-home behavioral skills-based virtual reality (VR) for chronic low back pain: 3-month follow-up results. (in development)

# What's better for home-based management of chronic pain among rural Americans?



**painTRAINER✓**

***Vs***



**EaseVRx™**

# Expanding Access to Behavioral Pain Medicine

- (1) Treat the full definition of pain
- (2) Lowest risk treatments first
- (3) Apply targeted resources to those with residual needs
- (4) Engage patients as **active participants** in their pain care
- (5) Equip patients to control their experience of pain
- (6) Enhance medical, surgical, and health outcomes

# Addressing Pain Care Disparities with Accessible Solutions

- Meet patients where they are
- Convenient
- Brief
- Include the family
- Home-based
- Leverage technology



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