THE COST-EFFECTIVENESS OF COMPLEMENTARY AND ALTERNATIVE TREATMENTS TO REDUCE PAIN

WORK IN PROGRESS

PI: Stephanie L. Taylor, PhD, GLA VA
Co-PI: Patricia M. Herman, ND, PhD, RAND
Acknowledgements

- **Additional Team Members:**
  - Co-PI: Karl Lorenz, MD, Palo Alto VA, Stanford
  - Qing Zeng, PhD, George Washington U. (formerly Palo Alto VA) (Natural Language Processing Team Lead)
  - Craig Morioka, PhD, Greater Los Angeles VA
  - Wei Yu, PhD, Palo Alto VA (Cost And Utilization Data Lead)
  - Nell Marshall, PhD, Palo Alto VA
  - Anita Yuan, PhD, Greater Los Angeles VA
  - Karen Chu, MS, Greater Los Angeles VA

- **Musculoskeletal Disorder Study Cohort:**
  - Bob Kerns, MD; Cynthia Brandt, MD; Joe Goulet, PhD Yale and VA Connecticut

- **Funding:** HSR&D Merit from 2014 NIH/VA/DOD Joint RFA
Study Background/Rationale

- Chronic pain and opioid use are prevalent among Veterans.

Toblin et al, 2011
Study Background/Rationale

- In the OEF/OIF/OND* Veteran population,
  - 62% have musculoskeletal disorders, most of which are accompanied by pain.
  - 58% have mental health conditions. Comorbid conditions include:
    - Anxiety
    - Depression
    - PTSD
    - Sleep Disturbance
    - Substance Abuse
    - Traumatic Brain Injury (TBI)
- There is a need to identify cost-effective non-pharmacological approaches to addressing pain and comorbid mental health conditions.

*Operation Enduring Freedom/Operation Iraqi Freedom/Operation New Dawn
Study Background/Rationale

- Some complementary and integrative health (CIH/CAM) approaches have some evidence for treating pain or comorbid mental health conditions and are being offered widely at the VA.
  - CIH/CAM = acupuncture, yoga, meditation, etc.
  - 2015 VA HAIG reports CIH offered broadly (facility level data).
  - Very little information on system-wide use by individuals.
  - CIH also not well-documented in medical records.
Study Background/Rationale

This study leverages the VA’s existing databases to measure:

- the extent of CIH use in the population of OEF/OIF/OND* Veterans with musculoskeletal pain
- its impact on pain and opioid use
- its total cost
- its cost-effectiveness

*Operation Enduring Freedom/Operation Iraqi Freedom/Operation New Dawn
Research Questions/Specific Aims

1. Determine resource use involved & “cost” of CIH services to VA
   - Big challenge is identifying CIH use
2. Determine cost-effectiveness of CIH for pain
   - Main analysis
3. Determine cost-effectiveness of CIH for co-morbid pain mental health conditions
   - Analysis of subset with both pain & 1+ MH
4. Interpret results and integrate findings into recommendations with Advisory Board help
Design and Methodology

- Cohort: Mostly OIF/OEF/OND veterans with chronic musculoskeletal disorder pain
  - Using the VA healthcare system during 2010-2013
- Chronic musculoskeletal disorder pain = either:
  - 2 or more MSD ICD9 codes “likely to represent chronic pain” (from Tian et al*) separated by 30-365 days
  OR
  - 2 or more MSD ICD9 codes within 90 days and with 2 or more pain scores ≥4 at 2+ visits within 90 days

Examples of “likely to represent chronic pain”*:

- Psychogenic pain
- Central pain syndrome
- Joint pain
- Anklosing spondylitis
- Arthritis of the spine
- Myelopathy
- Schmorl’s nodes
- Disc degeneration
- Postlaminectomy syndrome
- Calcification of cartilage/disc
- Spinal stenosis
- Cervicalgia
- Lumbago
- Fibrositis
- Fibromyalgia
- Myelopathy
- Coccydynia
- Neuralgia
- Faciitis
- Pain in Limb
- Backache

Design and Methodology- Defining Pain

- ICD9 code groupings for 2\textsuperscript{nd} criterion – one of these types of pain + pain scores $\geq 4$
  - Back pain
  - Neck pain
  - Joint pain
  - Osteoarthritis
  - Temporomandibular disorder
  - Fibromyalgia
<table>
<thead>
<tr>
<th>Pain Types</th>
<th>Frequency</th>
<th>Percent*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Back pain</td>
<td>279,306</td>
<td>52%</td>
</tr>
<tr>
<td>Joint pain</td>
<td>209,350</td>
<td>39%</td>
</tr>
<tr>
<td>Neck pain</td>
<td>89,522</td>
<td>17%</td>
</tr>
<tr>
<td>Osteoarthritis</td>
<td>40,850</td>
<td>8%</td>
</tr>
<tr>
<td>Fibromyalgia</td>
<td>38,790</td>
<td>7%</td>
</tr>
<tr>
<td>Temporomandibular disorder</td>
<td>401</td>
<td>0%</td>
</tr>
<tr>
<td><strong>Total Cohort</strong></td>
<td><strong>540,042</strong></td>
<td><strong>100%</strong></td>
</tr>
<tr>
<td>Multiple MSD diagnoses</td>
<td>103,934</td>
<td>19%</td>
</tr>
</tbody>
</table>

*Percentages do not add to 100% because 19% of the cohort have multiple MSD diagnoses.
Design and Methodology

- **Aim 1:** Identifying 8 types CIH use via CPT and CHAR codes and natural language processing (NLP)
- **Aims 2 and 3:** Cost-effectiveness analysis using double robust methods to create comparable groups
- **Aim 4:** VA-based Advisory Board to help with inputs, and interpretation and integration of results
# How CIH Is Being Identified

<table>
<thead>
<tr>
<th>CIH Type</th>
<th>NLP</th>
<th>CPT Codes</th>
<th>CHAR Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acupuncture</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Biofeedback</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Guided imagery</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Massage</td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Meditation</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Tai Chi</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Yoga</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Hypnosis</td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Chiropractic*</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Also identified through provider type codes.
Natural Language Processing (NLP)

- A text mining technology that can search billions of pieces of electronic natural language text — e.g., notes in clinical records
- Uses a search technology that “teaches” machines to find particular words/terms in text and interpret them correctly
Cost-Effectiveness Analysis (CEA)

- Basic CEA is: \( \frac{\Delta \text{ Costs}}{\Delta \text{ Effects}} \)
- Comparison is between vets with chronic MSD pain using CIH and those who do not use CIH
  - Using double robust methods for comparisons
  - Combination of propensity scores and regression
- Effects measured using pain numerical rating scale (NRS) across the year
  - Also, will be measuring opioid use over year
- Costs are VHA healthcare utilization costs
  - VHA perspective
- Sensitivity analyses to test assumptions
Results To Date

- Cohort of mostly OEF/OIF/OND Veterans identified
  - Across both inclusion criteria 540,042 veterans with chronic musculoskeletal chronic pain
    - 99% of these were identified by ICD9s “likely” for chronic pain
    - 91% of these were identified by ICD9s and ≥4 pain scores
    - So either inclusion criterion alone could have generated most of our cohort

- CIH use from different measures calculated
- Merging with demographic, pain, opioid use and cost data
## Frequency of CIH Use in Cohort

<table>
<thead>
<tr>
<th>CIH Type</th>
<th>% of Cohort</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meditation</td>
<td>16%</td>
</tr>
<tr>
<td>Yoga</td>
<td>7%</td>
</tr>
<tr>
<td>Acupuncture</td>
<td>6%</td>
</tr>
<tr>
<td>Biofeedback</td>
<td>3%</td>
</tr>
<tr>
<td>Chiropractic</td>
<td>4%</td>
</tr>
<tr>
<td>Guided imagery</td>
<td>4%</td>
</tr>
<tr>
<td>Massage</td>
<td>2%</td>
</tr>
<tr>
<td>Tai Chi</td>
<td>2%</td>
</tr>
<tr>
<td>Hypnosis</td>
<td>0.1%</td>
</tr>
<tr>
<td>Any of the above</td>
<td>27%</td>
</tr>
</tbody>
</table>
## Demographics – all are number (%) unless indicated

<table>
<thead>
<tr>
<th>Variable</th>
<th>Total Cohort (n=540,042)</th>
<th>CIH Users (n=129,521)</th>
<th>Control (n=348,157)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, mean (SD)</td>
<td>38.9 (8.5)</td>
<td>38.7 (8.4)</td>
<td>39.0 (8.5)</td>
</tr>
<tr>
<td>Female</td>
<td>95,893 (17.8)</td>
<td>29,078 (22.5)</td>
<td>54,030 (15.5)</td>
</tr>
<tr>
<td>Married</td>
<td>250,290 (46.4)</td>
<td>53,675 (41.4)</td>
<td>93,983 (27.0)</td>
</tr>
<tr>
<td>Divorced/Separated/Widowed</td>
<td>154,579 (28.6)</td>
<td>41,396 (32.0)</td>
<td>169,252 (48.6)</td>
</tr>
<tr>
<td>Single/Never Married</td>
<td>132,843 (24.6)</td>
<td>34,214 (26.4)</td>
<td>82,990 (23.8)</td>
</tr>
<tr>
<td>Service connected-ness &gt;=50%</td>
<td>164,345 (30.4)</td>
<td>48,667 (37.6)</td>
<td>93,751 (26.9)</td>
</tr>
</tbody>
</table>
Plan for the Cost-Effectiveness Analyses

• Use 1 year of pain and healthcare utilization data:
  • For CIH users, year begins with first use of CIH
  • For controls, year begins at roughly the same amount of time after individual qualified for the cohort

• Healthcare utilization data from CDW and VA Fee Basis files
  • Cost per healthcare event will come from average cost database
  • Costs reported in total and by outpatient visits, labs and imaging; inpatient care, ER visits, and medications
  • Opioid use tracked specifically
Plan for the Cost-Effectiveness Analyses (CEA) (Cont.)

Primary analysis: Any CIH use identified by **codes**
- Possible secondary analyses by CIH type – dependent on numbers: acupuncture, chiropractic, massage

- Secondary analysis: Any CIH use identified by codes or NLP “Yes”
  - Possible secondary analyses by CIH type – dependent on numbers: acupuncture, meditation, yoga

- Sensitivity analysis: Any CIH use identified by codes or NLP “Yes” or NLP “Probably yes”
  - Possible secondary sensitivity analyses by CIH type – dependent on numbers: acupuncture, meditation, yoga

All CIH use datasets will be run against a **control group** that is devoid from any mention of CIH use
Quasi-Experimental Design

• We did not randomly allocate service members to use CIH or not – they chose this care
  • Self-selection bias
• Correct for this by identifying an appropriate control group – one that is identical to the CIH use group except that they did not use CIH
• Several methods available to identify an appropriate control group:
  • Simple matching, propensity scores, regression modeling, double robust estimation
Matching On:

• Age
• Sex
• Race/ethnicity
• Marital status
• Means test (co-payments required or not)
• Service connectedness
• Percent disability
• Physical and psychiatric comorbidities
• Insurance status
• VA facility/station
Double Robust (DR): Conceptual Model

Double Robust Statistical Approach

• Step 1: Model for probability of receiving treatment as a function of covariates (logistic) → weights

• Step 2: Separate regressions for exposed and unexposed individuals’ outcomes as a function of covariates and risk factors → 2 sets of predicted outcomes for each individual

• Step 3: Each predicted outcome from these regressions is given a weight (IPW) from the first model to create a set of expected observations that are then compared statistically (e.g. z-test)
Challenges So Far

- Using NLP to identify CIH users and non-users
  - somewhat subjective interpretation of notes
  - Unclear if CIH documented in notes is internal or external to VA
- CIH use codes also have challenges
  - Almost no one using CHAR codes during the 2010-2013 period of interest
  - CPT4 codes – very few exist for CIH and they are not always used
- Determining an appropriate start date for controls
Payoff to the VA for this Research

- Estimates of:
  - Overall CIH use - multimethod measure
  - Cost of CIH use (VA investment in CIH)
  - Impact of CIH use on healthcare utilization
  - Impact of CIH use on opioid use and pain
- Results could affect the offer and level of funding for CIH use for chronic musculoskeletal pain and:
  - Improve Veterans’ health
  - Reduce their use of opioids
  - Allow for more efficient use of VA healthcare resources
Stay Tuned: Next Steps

- This summer – preliminary cost effectiveness results
- December 2017 – final results
- Collaboration - We would be excited to collaborate with others (e.g., apply these cost effective methods to other studies of CIH)