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

WORK IN PROGRESS

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Acknowledgements

- **Additional Team Members:**
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  - Qing Zeng, PhD, George Washington U. (formerly Palo Alto VA) (Natural Language Processing Team Lead)
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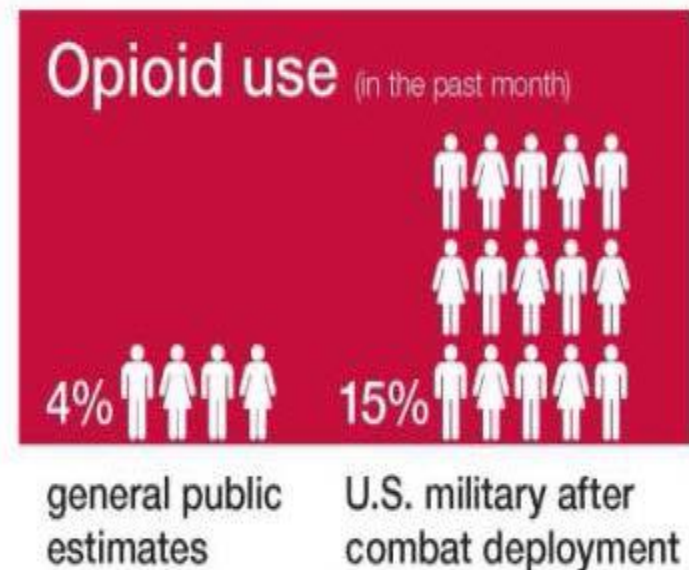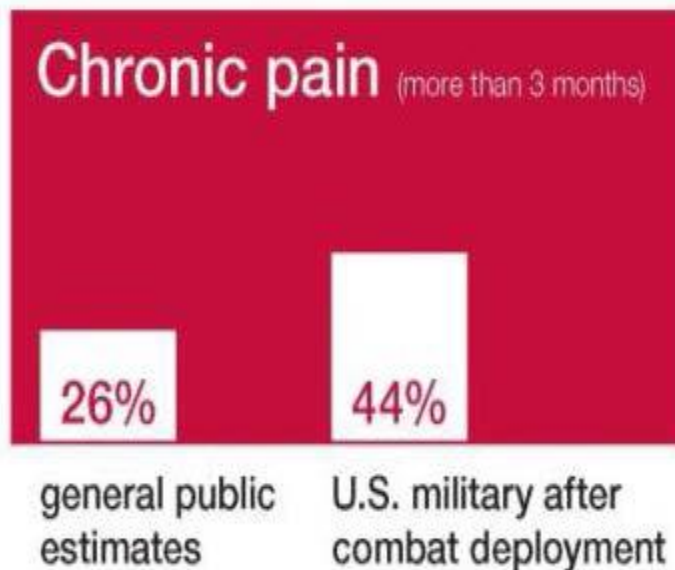 - Karen Chu, MS, Greater Los Angeles VA

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

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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 $\geq$4 at 2+ visits within 90 days

*From Tian et al, J Am Med Inform Assoc. 2013; 20:e275-e280.

Design and Methodology- Defining Pain

- Examples of "likely to represent chronic pain"*:
  o Psychogenic pain
  o Central pain syndrome
  o Joint pain
  o Anklosing spondylitis
  o Arthritis of the spine
  o Myelopathy
  o Schmorl's nodes
  o Disc degeneration
  o Postlaminectomy syndrome
  o Calcification of cartilage/disc
  o Spinal stenosis
  o Cervicalgia
  o Lumbago
  o Fibrositis
  o Fibromyalgia
  o Myelopathy
  o Coccydynia
  o Neuralgia
  o Faciitis
  o Pain in Limb
  o Backache

*From Tian et al, J Am Med Inform Assoc. 2013; 20:e275-e280.

Design and Methodology- Defining Pain

- ICD9 code groupings for 2nd criterion – one of these types of pain + pain scores >=4

  - Back pain
  - Neck pain
  - Joint pain
  - Osteoarthritis
  - Temporomandibular disorder
  - Fibromyalgia

MSD Pain Types – person level

Pain Types	Frequency	Percent*
Back pain	279,306	52%
Joint pain	209,350	39%
Neck pain	89,522	17%
Osteoarthritis	40,850	8%
Fibromyalgia	38,790	7%
Temporomandibular disorder	401	0%
Total Cohort	540,042	100%
Multiple MSD diagnoses	103,934	19%

*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

CIH Type	NLP	CPT Codes	CHAR Code
Acupuncture	X	X	X
Biofeedback	X	X	X
Guided imagery	X		X
Massage		X	X
Meditation	X		x
Tai Chi	X		X
Yoga	X		X
Hypnosis		X	X
Chiropractic*		X	

* 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

Keyword Identification   Annotation   Apply to Cohort

Text Sampling   Training /Testing
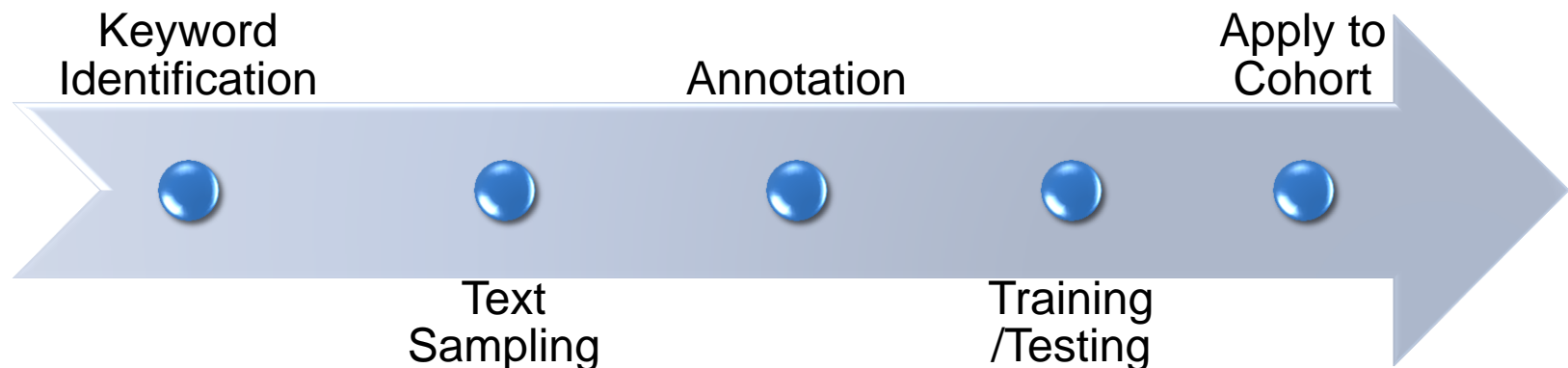
Cost-Effectiveness Analysis (CEA)

- Basic CEA is: (Δ Costs) / (Δ 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 w/chronic musculoskeletal chronic pain
    - 99% of these were identified by ICD9s "likely" for chronic pain
    - 91% of these were identified by ICD9s and $\geq$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

CIH Type	% of Cohort
Meditation	16%
Yoga	7%
Acupuncture	6%
Biofeedback	3%
Chiropractic	4%
Guided imagery	4%
Massage	2%
Tai Chi	2%
Hypnosis	0.1%
Any of the above	27%

Demographics – all are number (%) unless indicated

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

Plan for the Cost-Effectiveness Analyses

- Use <u>1 year</u> 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 <u>codes</u>

- 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 <u>control group</u> 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
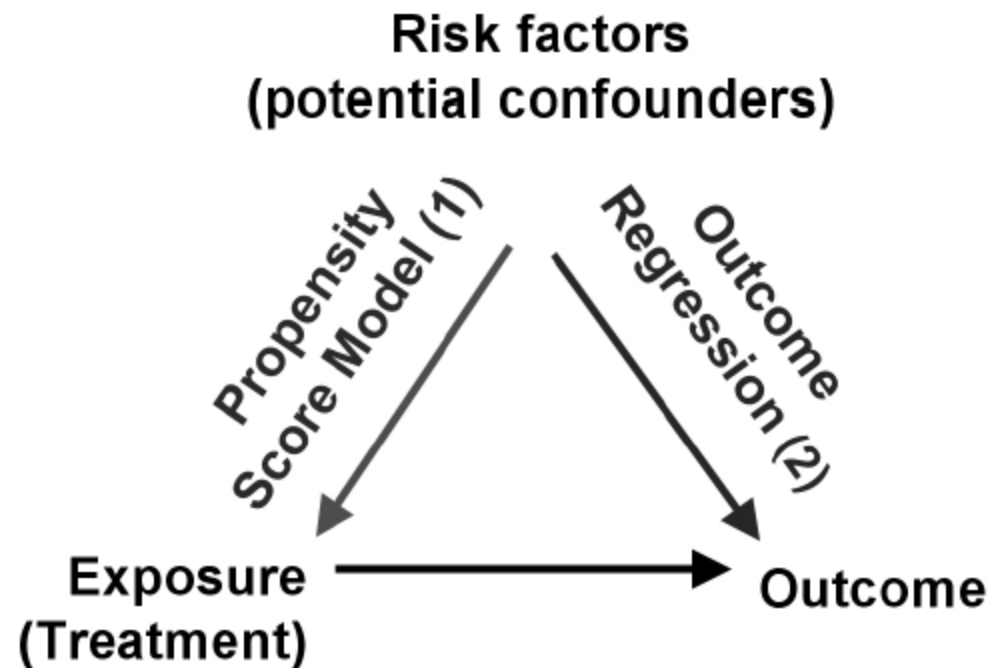
Double Robust (DR): Conceptual Model

Figure 1. Component models of the DR estimator.

Source: Funk MJ, et al, 2010. Chapter 4. DR estimation of treatment effects. In *Analysis of Observational Data Using SAS*. Faries et al (eds). SAS Institute: Cary, NC. pp. 85-104.

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)