GME/AHEAD Residency Program

AHEAD Personnel
Director for Applied Research and Analytics: Joanne Salas
Program Coordinator: Lizzie Ward
Biostatisticians as assigned

Partnership Description: This partnership between the AHEAD Institute and the SSM/SLU Office of Graduate Medical Education provides research training and analytic support to residents and fellows across all programs, through a competitive grant process, to complete their required scholarship. The AHEAD Institute's blend of mentorship, skilled data managers and biostatisticians, and the clinical expertise of SSM Health/SLU faculty enhance the learning experience and research contributions of all participants.

Ms. Joanne Salas, Director of Applied Research and Analytics, will guide trainees through a series of exercises, starting with a micro-learning course "Medical Residents and Fellows: Basic Principles of Research" offered through the CITI Program. These exercises will teach trainees how research is conducted and evaluated, from how to formulate appropriate research questions to how to work with research teams.

Trainees will be encouraged to use the SLUCare-SSM Virtual Data Warehouse (VDW) or the Healthcare Cost and Utilization Project (HCUP) data for their projects, with exceptions (see below). These data sources offer a unique opportunity to answer clinically relevant questions in already de-identified, research-ready databases from a large number of patients.

The VDW captures electronic health record data from rural and urban settings from all clinical encounters from approximately 5-million patients in St Louis, MO; mid-Missouri; southern IL; Oklahoma City, OK, and surrounding areas; and southern WI regions. Trainees can generate research questions using full years of VDW data from 2016-2023. There is a lag of 1-year at the beginning of each calendar year, meaning that at the start of the calendar year 2025, the available data will range from 2016-2023. The data includes encounter types and dates, ICD-10 diagnoses and dates, procedure codes and dates (CPT/ICD9/ICD10), prescription orders, laboratory orders and results, vital signs, and demographics.

The HCUP data includes:

a) Nationwide Inpatient Sample (1998-2017): The NIS is the largest publicly available all payer inpatient care database in the US, containing data on more than 7 million hospital stays. Its large sample is ideal for developing national and regional estimates and enables analyses of rare conditions, uncommon treatments and special populations.
b) Kids' Inpatient database (1997-2016): The KID is the largest publicly available all-payer pediatric inpatient care database in the United States, containing data from 2-3 million hospital stays. Its large sample size is ideal for developing national and regional estimates and enables analyses of rare conditions, such as congenital anomalies, as well as uncommon treatments, such as organ transplantation. The KID has been produced every three years.

c) Nationwide Readmissions Database (2016-2019): The NRD is a unique and powerful database designed to support various types of analyses of national readmission rates for all patients regardless of the expected payer for the hospital stay. The NRD includes discharges for patients with and without repeat hospital visits in a year and those who have died in the hospital. Repeat stays may or may not be related. This database addresses a large gap in health care data: the lack of nationally representative information on hospital readmissions for all ages.

Exceptions to the VDW: The VDW and HCUP are well-suited for research across all medical specialties. Joanne Salas will review and approve exceptions to the use of other data sources and methodologies, given the scope of the project and the overall goals of the educational requirement.

Partnership Goals:

- Develop trainees' research knowledge and skills needed for their required residency/fellowship scholarship.
- Provide trainees with best practices and resources that they can utilize in future research initiatives.
- Produce high-quality research outputs, supported by analyses from AHEAD biostatisticians. This educational process and its outputs are designed to satisfy the trainees' research requirements and to introduce trainees to the clinical research process in a controlled and empowering environment.

Learning Objectives for Trainees:

1. Trainees will gain an understanding of the clinical research process, described in the CITI micro-course "Medical Residents and Fellows: Basic Principles of Research." Trainees must complete the following 8 modules and provide a certificate of completion to Joanne Salas
   a) Introduction to Research
   b) Research Study Design
   c) Clinical Research Methodology
   d) Critical Review of Research Literature
   e) The Research Protocol
   f) IRBs, Safety Review, and Monitoring
   g) Research Presentation and Publication
   h) Regulatory Agencies & Compliance in Clinical Research
2. Trainees will acquire vocabulary and conceptual knowledge to discuss research and work effectively with a collaborative research team that includes mentors, methodologists, and biostatisticians.
3. Trainees will learn to summarize literature in a scientific literature review, providing the context necessary for a new study.
   a) Trainees will learn the formal process of study design by creating a workflow, creating a timeline, writing research questions in the PI(E)COT format that follow the FINER criteria, organizing study design elements, and operationalizing pertinent study variables and concepts.
   b) Trainees will learn to interpret research outputs from the perspective of a clinician and accurately present findings to other clinicians.

Expectations
Joanne Salas acts as the primary mentor for trainees, strengthening their research skills through exercises and assignments that contribute to a high-quality study design.

All trainees are expected to be engaged in their project, willing to learn from AHEAD personnel, actively participate in meetings, and complete assignments in a timely manner.

Once the project design is established, Joanne Salas will assign a biostatistician to execute the project's agreed upon Scope of Work, which will include agreed upon mock tables that will be included in delivarables. At the project's conclusion, the biostatistician and Joanne Salas provide a preliminary interpretation of results.

Project scopes will be designed to satisfy the GME residency research requirement. Submission of results as conference abstracts will be encouraged, if applicable. Any extension of scope or desire to proceed with more in-depth analyses for a manuscript are not within scope of the GME program. Joanne Salas and Lizzie Ward will discuss the next steps in these situations if needed.

Lizzie Ward serves in an administrative role under Joanne Salas's supervision.

Appendices
- Appendix I – Example timeline and trainee assignments
- Appendix II – What is PI(E)COT and FINER
- Appendix III – Example literature search worksheet
- Appendix IV – Example Study Design Worksheet and Operational Definition Table
- Appendix V – Example Poster Presentations

Appendix I – Example timeline and trainee assignments

Timeline	Who	Monthly Meeting Agenda	Trainee Assignments (due prior to next month's meeting)
Month 1	**Joanne, Trainee**	- Overview of program, expectations, timelines, milestones, assignments - Explore topic of interest and potential research questions - Create recurring meeting schedule	1. Complete the 8 CITI modules 2. Conduct a literature search and complete literature review with ≥ 5 articles 3. Create a research question in the PI(E)COT format for review
Month 2	**Joanne, Trainee**	- Answer questions related to CITI modules - Review literature review worksheet - Finalize research question - Introduce study design worksheet and operational definitions	1. Summarize literature review in one paragraph 'introduction'. 2. Start study design worksheet: Complete the sections for inclusion criteria, exposure of interest, and covariates/confounders. 3. Gather operational definitions for variables
Month 3	**Joanne, Trainee**	- Finalize study design worksheet - Joanne begins to create a 'specification' document for the biostatistician's analysis	1. Finalize study design worksheet and operational definition table
Month 4	**Joanne, Trainee, analyst**	- Introduce the analyst and trainee - Review study design worksheet - Discuss the final deliverables (tables) - Joanne completes of Scope of Work	1. Sign Scope of Work
Month 5	**Joanne, Trainee, analyst**	- Review analyses and outputs - Analyst provides example interpretations - Joanne provides example posters	1. Work on poster for GME symposium
Month 6	**Joanne, Trainee**	- Review GME symposium poster - Answer outstanding questions - Close project	
*** If an exception is granted to use a different data source or methodology other than the VDW or HCUP, this timeline will be revised at the discretion of Joanne Salas based on the needs of the project.** ***If the trainee has an external deadline for a conference abstract, Joanne Salas will work with the trainee to expedite the timeline and meet the deadline, if feasible.**			

Appendix II – What is PI(E)COT and FINER

*CITI modules will address PI(E)COT and FINER but added here for reference

PI(E)COT is a helpful approach to formulating meaningful research questions:

- (P) – Population/Patient/Problem: Who is the focus of your research question?
- (I) – Intervention (if applicable): Action or treatment
- (E) – Exposure (if applicable): Instead of an intervention, this may be an environmental or lifestyle factor that may influence an outcome
- (O) – Outcome: The specific outcome that may be affected by your intervention or exposure
- (C) – Comparison: The control group or comparison group.
- (T) – Time: The specific timeframe for the duration of the intervention or follow-up. This may be optional depending on design.

Example PI(E)COT question related to an intervention: In adults over 50 years of age (P), does TDAP vaccination (I) versus no vaccination (C) lead to a lower risk of dementia (O) over a 15-year follow-up period (T)?

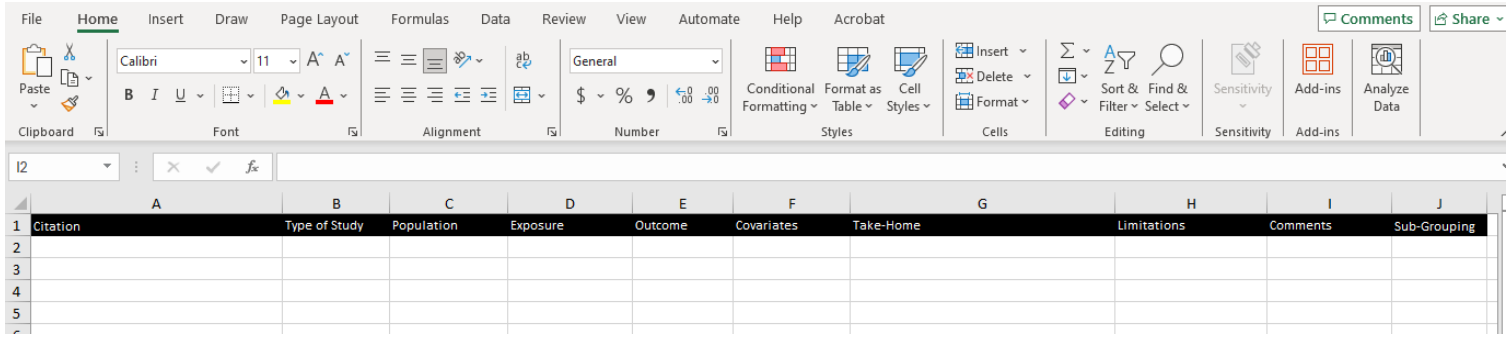
Example PI(E)COT question related to an exposure: Among pregnant women aged 12-45 years of age (P), does a pre-pregnancy diagnosis of opioid use disorder (E) versus no diagnosis (C) increase the risk of suicide attempts (O) during pregnancy (T)?

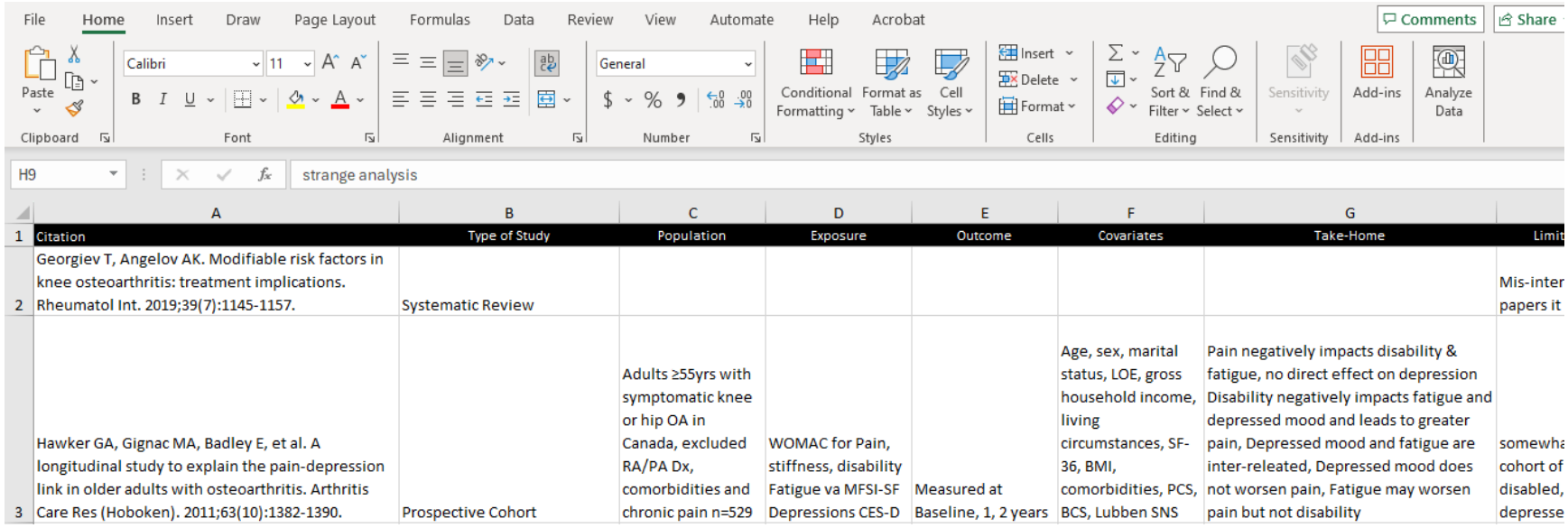
FINER Criteria: This is a helpful mnemonic to ensure researchers formulate a well-constructed and impactful research study. It is guided by summary of the literature and is useful when creating research that is clear and focused.

- (F) – Feasible: Research questions should be answered under objective aspects like time, scope, resources, expertise, and funding.
- (I) – Interesting: Does your question correspond to more practical and broader interests?
- (N) – Novel: Does the research fill existing gaps in knowledge, improve on methodological flaws in the literature, generate new hypotheses, or provide different findings?
- (E) – Ethical: Complies with principles of ethical research conduct
- (R) – Relevant: Does the research generate new knowledge, contribute to clinical practice or knowledge, stimulate further research, or provide more accurate answers to research questions?

Appendix III – Example literature search worksheet

*One of the most important aspects of formulating a meaningful research question is to search the literature and summarize/organize your literature search into easily digestible information. Most useful database search: PubMed https://pubmed.ncbi.nlm.nih.gov/
Example organization of literature search (excel sheet)





Appendix IV – Example study design worksheet and operational definition table

* Once you've identified your research question, data source, variables of interest (including operational definitions), it is helpful to organize the information into a formal study design worksheet that will act as a reference or template when meeting with the biostatistician. The operational definition table also serves as a template that biostatisticians will use to define the final, analytic variables that will be used in analysis. For the most part, most projects will follow this format, but format will be adjusted based on data source/project.

Study design worksheet

Project Title:

Investigator:

Literature review summary: This is a brief "introduction" paragraph that sets up your research question

Research Question: State what you want to investigate?

Dataset: What data will you be using

Population: (Describe the population you wish to include in the study)

Inclusion and Exclusion Criteria: restrictions on the population and data that need to be available to include an individual in the final analytic sample

Exposure of Interest: What will be the primary exposure or independent variable that you'd like to investigate?

Outcome of Interest: What is the outcome of interest?

Covariates: What confounders must we account for?

PLEASE SEE NEXT PAGE FOR EXAMPLE VARIABLE DEFINITION TABLE

<table>
<tr><td colspan="2">Example variable definitions – this is just an example and may look different based on your data source. This is from an EHR based data source</td></tr>
<tr><td>Variable</td><td>Definition</td></tr>
<tr><td>Index/baseline (date)</td><td>First PCL-5 in FY18-FY20 where: a) comorbid T2D-PTSD in 1-year prior; b) no T1DM or insulin fills in 2-years prior; and c) no microvascular complications in 2-years prior

PCL-5 is a summary score of 0 to 80</td></tr>
<tr><td>Follow-up time (months)</td><td>Months from index to study end date (incident outcome or censoring).
Censoring for each outcome:
Time to microvascular complication – death or last visit
Time to poor glycemic control – death or last HbA1c measurement</td></tr>
<tr><td>T2DM (yes or no)</td><td>ICD-9 code: 250.x0, 250.x2;
ICD-10 code: E11.x</td></tr>
<tr><td>PTSD (yes or no)</td><td>ICD-9 code: 309.81;
ICD-10 code: F43.1x
- 2 outpatient occurrences (on different days) in same 12-month period or 1 inpatient occurrence</td></tr>
<tr><td>T1DM (yes or no)</td><td>ICD-9 code: 250.x1, 250.x3;
ICD-10 code: E10.x</td></tr>
<tr><td colspan="2">Outcomes</td></tr>
<tr><td>Poor glycemic control (yes or no)</td><td>HbA1c in follow-up ≥7.5. First occurrence is date of onset</td></tr>
<tr><td>Any microvascular complication (yes or no)</td><td>Composite from list below. First occurring date is date of onset
<table>
<tr><th>Microvascular complication</th><th>ICD9</th><th>ICD10</th></tr>
<tr><td>Diabetic retinopathy</td><td>250.50, 250.52, 362.0x, 366.41</td><td>E11.3x, E13.3x, E14.3x, H28.0, H36.0</td></tr>
<tr><td>Diabetic neuropathy</td><td>250.60, 250.62, 357.2</td><td>E11.4x, E13.4x, E14.4x, G63.2, G59.0</td></tr>
<tr><td>Diabetic nephropathy</td><td>250.40, 250.42, 585.x</td><td>E11.2x, E13.2x, E14.2x, N08.3, N18.x</td></tr>
</table></td></tr>
<tr><td colspan="2">Exposures</td></tr>
<tr><td>PTSD severity (3-category as defined)</td><td>PCL-5 score:
Mild (0-32)
Moderate (33-65)
Severe (66-80)</td></tr>
<tr><td colspan="2">Comorbidity covariates – measured in 2-years prior to index. At least one occurrence/diagnostic code unless otherwise specified.</td></tr>
<tr><td>Depression (yes or no)</td><td>ICD-9 code: 296.2x, 296.3x, 311;
ICD-10 code: F32.0-F32.5, F32.9, F33.0-F33.3, F33.4x, F33.9
- 2 outpatient occurrences (on different days) in same 12-month period or 1 inpatient occurrence</td></tr>
<tr><td>Anxiety (yes or no)</td><td>ICD-9 code: 300.00, 300.01, 300.02, 300.23;
ICD-10 code: F40.1x, F41.0, F41.1, F41.9</td></tr>
</table>

	- Composite of panic disorder, anxiety disorder not otherwise specified, social phobia, and generalized anxiety disorder - 2 outpatient occurrences (on different days) in same 12-month period or 1 inpatient occurrence
Schizophrenia (yes or no)	ICD-9 code: 295.x; ICD-10 code: F20.x, F25.x
Bipolar disorder (yes or no)	ICD-9 code: 296.0x, 296.1x, 296.4x-296.8x; ICD-10 code: F30.x, F31.x
Alcohol abuse/dependence (yes or no)	ICD-9 code: 303.9x, 305.0x; ICD-10 code: F10.x
Any drug abuse/dependence (yes or no)	ICD-9 code: 304.0x, 304.1x, 304.2x, 304.3x, 304.4x, 304.5x, 304.6x, 304.7x, 304.8x, 304.9x, 305.2x, 305.3x, 305.4x, 305.5x, 305.6x, 305.7x, 305.9x ICD-10 code: F11.x, F12.x, F13.x, F14.x, F15.x, F16.x, F18.x, F19.x - Composite of sedative, cocaine, cannabis, amphetamine, hallucinogens, 'other', opioid, opioid with other SUD, other SUD excluding opioid, unspecified drug abuse/dependence.
Smoking/nicotine dependence (yes or no)	ICD-9 code: V15.82, 305.1; ICD-10 code: Z87.891, Z72.0, F17.20x, F17.21x Present in health factor data as current smoker
Adequate PTSD treatment (yes or no)	At least 9 unique clinic stops (clinic stop codes: 516, 540, 541, 561, 562) for PTSD psychotherapy in any 15-week period.
Adequate ADM treatment (yes or no)	At least 12 weeks of continuous use. Continuous use is defined as no gaps > 30 days in fills. All SSRI, SNRI, MAOI, TCA, and other types.
Atypical antipsychotic use (yes or no)	Sustained use = is at least 2 fills in any 6-month period. Atypical antipsychotics: aripiprazole, asenapine, brexipiprazole, cariprazine, clozapine, iloperidone, lurasidone, olanzapine, paliperidone, pimavanserin, quetiapine, risperidone, ziprasidone
Obesity (yes or no)	Last BMI on/before index is ≥ 30
Demographic and other information	
Age at index	18-39, 40-49, 50-59, ≥60
Race	Black, White, Other
Gender	Male, female

Appendix V – Example Poster Presentations

A longitudinal analysis of depressive symptoms and pain intensity and interference: A latent class growth analysis

Joanne Salas[1], Jeffrey Scherrer[2], Lisa Miller-Matero[3], Tim Chrusciel[1], Scott Secrest[2], Ryan Carpenter[4]

1) AHEAD Institute, Saint Louis University School of Medicine; 2) Department of Family and Community Medicine, Saint Louis University School of Medicine; 3) Center for Health Policy and Health Services Research, Henry Ford Health; 4) Department of Psychology, University of Notre Dame

BACKGROUND

- Pain and depression have a bidirectional relationship
- Long-term opioid use associated with depression

Objectives:

1) **Determine 12-month pain and depressive symptom trajectories**
2) **Describe associations of demographics and mental health comorbidities with pain and depression trajectories**

METHODS

- **Prospective cohort study**
- **Sample (n=761)**:
  - Aged 18-80 years old
  - New 30-90 day prescription opioid users, non-cancer pain
  - Web-based surveys – self-administered or over telephone
    - Baseline and 12-monthly follow-up surveys
  - Present study: At least 3 completed monthly surveys
- **Longitudinal Measures**
  - Depressive symptoms: PHQ-9 total scores at each month (0-27)
  - Pain intensity and interference: PEG-3 at each month (0-10)
- **Baseline characteristics**
  - Demographics: Age, gender, race
  - Daily opioid use, # pain sites, pain interference and severity
  - Anhedonia (SHAPS), vital exhaustion (VE), anxiety (GAD), PTSD (PCPTSD), problems with opioids (PODS), history of SUD, current smoker, current depression (MDD)
- **Analysis**
  - Latent class growth analysis (LCGA) of PHQ-9 and PEG scores
  - Multinomial logistic regression

Results

Table 1. Baseline characteristics (n=761)

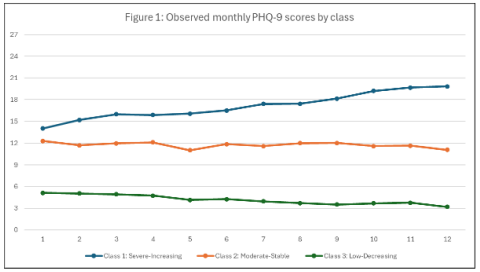
n (%) or mean (±sd)	Total
Age	53.5 (±11.7)
Gender	
Male	238 (31.3)
Female	523 (68.7)
Race	
White	539 (70.8)
Black	187 (24.6)
Other	35 (4.6)
Daily opioid	515 (67.7)
# pain sites	6.1 (±3.6)
BPI Pain severity	5.9 (±1.7)
BPI Pain interference	6.7 (±2.1)
PODS positive	130 (17.1)
SHAPS positive	229 (30.1)
VE positive	159 (20.9)
GAD positive	162 (21.3)
PCPTSD positive	132 (17.4)
MDD Current	176 (23.1)
History of any SUD	98 (12.9)
Current smoker	182 (23.9)

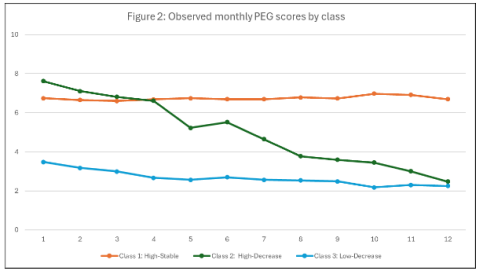
Table 2. Relationship of baseline characteristics with PHQ trajectory, multinomial logistic regression (n=761)

Baseline variable, OR (95% CI)	Severe – Inc vs. Low-dec	Moderate-Stable vs. Low – Dec
Age	0.98 (0.96-1.01)	1.00 (0.98-1.01)
Gender		
Male	1.00	1.00
Female	0.94 (0.50-1.78)	1.15 (0.73-1.79)
White race	1.57 (0.82-2.99)	**1.79 (1.14-2.83)**
# pain sites	**1.22 (1.13-1.33)**	**1.19 (1.12-1.27)**
Pain severity	1.18 (0.94-1.46)	1.06 (0.92-1.23)
Pain interference	**1.34 (1.08-1.65)**	1.06 (0.94-1.21)
Daily opioid	0.73 (0.38-1.39)	0.87 (0.56-1.36)
PODS positive	0.95 (0.44-2.02)	**1.69 (1.01-2.82)**
Anhedonia	**1.91 (1.01-3.63)**	1.47 (0.93-2.33)
VE positive	**3.44 (1.69-7.02)**	**2.18 (1.26-3.79)**
GAD positive	1.95 (0.95-3.99)	1.41 (0.81-2.46)
PCPTSD positive	1.99 (0.99-4.04)	**2.19 (1.27-3.78)**
MDD Current	0.90 (0.45-1.81)	1.49 (0.91-2.45)
History of any SUD	1.23 (0.56-2.75)	0.84 (0.46-1.52)
Current smoker	1.61 (0.87-2.97)	**1.60 (1.03-2.51)**

Table 3. Relationship of baseline characteristics with PEG trajectory, multinomial logistic regression (n=761)

Baseline variable, OR (95% CI)	High-Stable vs. Low-Dec	High - Dec vs. Low – Dec
Age	1.01 (0.99-1.03)	1.03 (1.01-1.06)
Gender		
Male	1.00	1.00
Female	0.94 (0.60-1.47)	0.81 (0.43-1.55)
White race	0.69 (0.43-1.11)	0.96 (0.48-1.94)
# pain sites	**1.24 (1.16-1.34)**	**1.14 (1.03-1.26)**
Pain severity	**1.80 (1.53-2.12)**	**1.51 (1.20-1.89)**
Pain interference	**1.28 (1.14-1.44)**	**1.50 (1.24-1.81)**
Daily opioid	0.75 (0.47-1.18)	0.69 (0.36-1.34)
PODS positive	1.15 (0.64-2.06)	0.90 (0.38-2.11)
Anhedonia	1.10 (0.65-1.87)	1.09 (0.51-2.33)
VE positive	1.50 (0.72-3.13)	0.83 (0.28-2.45)
GAD positive	1.22 (0.61-2.46)	1.09 (0.40-2.97)
PCPTSD positive	0.99 (0.50-1.97)	1.07 (0.39-2.90)
MDD Current	1.38 (0.76-2.50)	0.97 (0.40-2.38)
History of any SUD	1.50 (0.78-2.88)	0.93 (0.33-2.62)
Current smoker	1.52 (0.89-2.59)	1.28 (0.59-2.78)





Conclusions

- Three distinct patterns of depressive and pain symptoms were found:
  - PEG: High-Stable (60.3%), High-Decrease (8.5%); Low-Decrease (31.1%)
  - PHQ-9: Severe-Increase (9.9%), Moderate-Stable (24.0%); Low-Decrease (66.1%)
- Depressive symptoms: a) # of pain sites, high PODS, VE and PTSD associated with Moderate-Stable depressive symptoms; b) VE, anhedonia, pain interference and # of pain sites associated with High-Stable depressive symptoms
- PEG: a) # pain sites and baseline pain severity and interference associated with High-Stable and High-Decreasing symptoms
- Identifying factors contributing to worsening depression during pain could reveal when to intervene before patients develop depression
- Intervening upon depression could improve pain outcomes

Disclosures

- Declaration of interests: no conflicts of interest
- Funding: This study was supported by NIDA Grant R01DA043811

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The relationship of PTSD symptom type and severity with Type 2 diabetes (T2DM)

Joanne Salas[1,2], Jeffrey Scherrer[2,3], Paula Schnurr[4], Kenneth Freedland[5], Beth Cohen[6]

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BACKGROUND

- Poor health behaviors are associated with PTSD
- PTSD vs. no PTSD associated with greater risk of T2DM
- PTSD improvement is associated with lower risk of T2DM

Objectives: Among a sample of patients with comorbid PTSD-T2DM

1) **Is PTSD severity associated with T2DM complications?**
2) **Are individual PTSD symptom types associated with T2DM complications?**

METHODS

- **Retrospective cohort FY15-22 (Veterans Health Administration)**
- **Sample (n=23,161):**
  - Aged 18-80 years old with comorbid PTSD-T2DM at index
  - No microvascular complications or insulin fills at index
  - Controlled T2DM (HgA1c < 7.5)
  - Index – first PTSD Checklist score for DSM-V (PCL-5) where PTSD-T2DM evident
- **Exposure based on index PCL-5:**
  - PCL-5 severity (mild 0-32; moderate 33-65; severe 66-80)
  - Symptom cluster: Presence (y/n)
    - Intrusion, avoidance, negative alterations in cognition and mood, hyperarousal
- **Outcomes (2-9 years possible follow-up):**
  - Microvascular complication (diabetic retinopathy, neuropathy, or nephropathy)
  - Starting insulin
  - Poor glycemic control (HgA1c ≥ 7.5)
  - All-cause mortality
- **Covariates:** Demographics, healthcare utilization, psychiatric and physical comorbidities
- **Analysis (SAS v9.4):**
  - Entropy balancing to balance covariates across exposures
  - Entropy balance weighted competing risk survival models

Results

Table 1. Selected baseline characteristics and outcomes for comorbid PTSD-T2D veterans (n=23,161)

	n(%) or mean(±sd)
Demographics	
Age	
18-39	2293 (9.9)
40-49	4555 (19.7)
50-59	5881 (25.4)
≥60	10432 (45.0)
Male gender	20377 (88.0)
Race	
Black	7057 (30.5)
Other	1224 (5.3)
White	14880 (64.2)
Married	14060 (60.7)
Region	
Northeast	2540 (11.0)
Midwest (North central)	4236 (18.3)
South	11648 (50.3)
West	4737 (20.5)
PTSD-T2D	
PCL severity	
Mild	3959 (17.1)
Moderate	15612 (67.4)
Severe	3590 (15.5)
Outcomes	
Start insulin	2637 (11.4)
Poor glycemic control	9802 (42.3)
Any microvascular outcome	9889 (42.7)
All-cause Mortality	1606 (6.9)

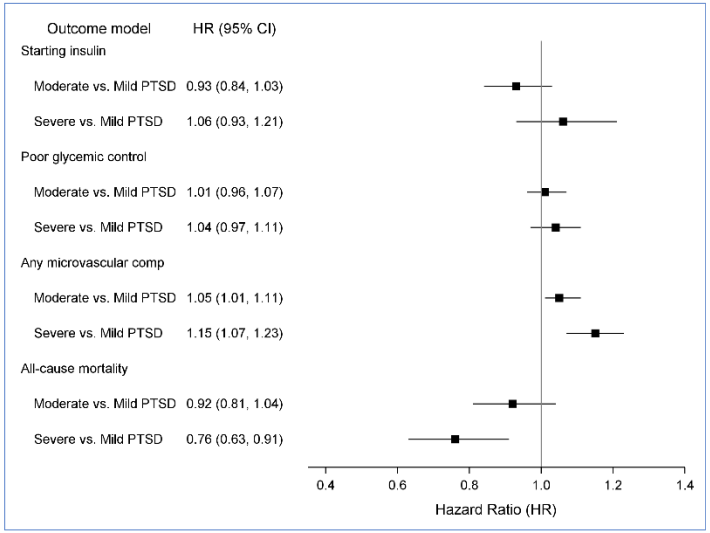

Table 2. Exploratory analysis of presence vs. absence of PCL-5 symptom cluster. Fully adjusted models.[a]

Symptom class	Starting insulin	Poor glycemic control	Microvascular complication	Mortality
	HR (95% CI)	HR (95% CI)	HR (95% CI)	HR (95% CI)
Intrusion	0.83 (0.60-1.14)	0.97 (0.83-1.15)	1.07 (0.90-1.26)	0.94 (0.64-1.38)
Avoidance	1.08 (0.83-1.41)	0.98 (0.87-1.11)	0.89 (0.80-1.01)	0.98 (0.73-1.33)
Negative cognitive and mood symptoms	1.09 (0.80-1.49)	0.96 (0.83-1.10)	**1.16 (1.01-1.33)**	0.87 (0.63-1.20)
Hyperarousal	**0.58 (0.43-0.80)**	0.89 (0.77-1.04)	0.91 (0.78-1.06)	0.94 (0.67-1.33)

[a] Fully adjusted model controls for all confounders, PCL severity, and the presence/absence of the other 3 symptom clusters.

Conclusions

- PTSD severity is associated with an increased risk of any microvascular complications
- Preliminary evidence that type of PTSD symptom may be differentially related to T2D outcomes.
- More severe PTSD = lower all-cause mortality?? → might be due to more health care use and early detection of chronic disease.
- PTSD screening among patients with T2DM may be warranted
- Future directions:
  - How to further define PTSD phenotypes based on severity and symptom cluster
  - Focused treatment based on PTSD phenotype and improved diabetes management

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