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TITLE: Military Veterans with Eating Disorders: Prevalence, Incidence, Patterns of Comorbidity and Cost of Care

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CONTRACTING ORGANIZATION: The Children's Hospital Corporation d/b/a Boston Children's Hospital

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Boston Children's Hospital
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Boston, MA 02115

Boston VA Research Institute
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Western Institute for
Biomedical Research (now
known as Western Institute
for Veteran's Research)
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13. SUPPLEMENTARY NOTES

14. ABSTRACT

Scope: Eating disorders (ED), including anorexia nervosa, bulimia nervosa, and binge eating disorder, are serious illnesses that lead to disturbance in one's eating behaviors and can result in poorer health, lower quality of life, and long-term expensive treatment. Very little is known about the prevalence of ED and the patterns of co-occurring mental health and substance use problems among military Veterans. Our study is designed to estimate the prevalence, patterns of co-occurring illness, and costs of ED among Veterans so that we can evaluate the overall burden of disease to inform future design of effective ED screening and treatment programs for military Veterans.

Purpose: The purpose of our research activities is to use the largest and most comprehensive database of US military Veterans to: generate precise estimates of ED prevalence (% of Veterans with ED within a year) and incidence (new cases by year) among Veterans in the aggregate; estimate ED prevalence/incidence by sociodemographic groups, including by age, gender, race/ethnicity, obesity status, and age cohort; evaluate whether such co-occurring problems precede (and may lead to) ED or if they develop subsequently to an ED episode (and may be caused in part by ED); document the added utilization and cost of care to the Veterans Health Administration (VHA) associated with ED.

Major Findings:

At the end of Year 2, we continued to develop our EHR-based algorithm to identify ED on the aggregate and for ED subtypes among military Veterans. Once developed, we will evaluate its performance relative to chart review diagnosis gold standard. In Year 2 we assembled and trained a chart review team, developed a comprehensive chart review guide which provides step by step instructions related to the process and data elements to be reviewed, and completed the first phase of chart review validation (which involved calibrating ratings across reviewers and establishing criteria for classifying ED cases, possible cases, and non-ED cases). During Year 2 we also made additional progress towards Aims 2 and 3 of the study by developing step by step plans regarding the study design, merging of datasets, and matching of the ED group to controls. We cleaned and conducted preliminary analyses of specific VA data elements and agreed on a number of criteria that will be used to operationalize our variables of interest, including utilization by healthcare setting (emergency department, inpatient, outpatient, pharmacy), by payer (VA vs Medicaid/Medicare), and by year. The full execution of the analysis plan for Aims 2 and 3 will begin upon completion of Aim 1.

15. SUBJECT TERMS

NONE LISTED

16. SECURITY CLASSIFICATION OF:			**17. LIMITATION OF ABSTRACT**	**18. NUMBER OF PAGES**	**19a. NAME OF RESPONSIBLE PERSON** USAMRMC
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1. **INTRODUCTION:**

We will develop a robust and validated methodology to more accurately identify ED cases in the VHA than has previously been possible using electronic health record (EHR) data. Using our newly developed algorithm, we will generate precise estimates of the prevalence and incidence of ED among Veterans in the aggregate and by ED subtype and by sociodemographic group, patterns of mental health, and substance use comorbidities, and utilization and cost of care to the VHA and other public payers. Further, longitudinal analyses of a 17-year period of CDW will (i) examine whether prevalence and incidence have changed over time and as individuals age, (ii) identify comorbidities associated with increased risk of developing ED, and (iii) assess the cost of care of new ED cohorts over the 17-year period. Our planned research will produce the most robust estimates to date of the scope and impact of ED on Veterans' health as a whole and in high-risk subgroups, changes in incidence over time and with age, and the health services and cost burden posed by ED for the VHA and other public payer systems.

2. **KEYWORDS:** Veterans, cost, comorbidity, healthcare utilization, eating disorder, anorexia, bulimia, binge eating, EHR, algorithm

3. **ACCOMPLISHMENTS:** *The PI is reminded that the recipient organization is required to obtain prior written approval from the awarding agency Grants Officer whenever there are significant changes in the project or its direction.*

- **What were the major goals of the project?**

  - *List the major goals of the project as stated in the approved SOW. If the application listed milestones/target dates for important activities or phases of the project identify these dates and show actual completion dates or the percentage of completion.*

  - **Aim 1**: Develop a robust EHR-based algorithm to identify ED on the aggregate and for ED subtypes among military Veterans.
  - **Aim 2**: (a) Estimate the prevalence and incidence of ED and ED subtypes and (b) estimate the prevalence of comorbid mental health and substance use disorders among Veterans with ED in the aggregate and in high-risk subgroups defined by gender, race/ethnicity, obesity status, and age cohort.
  - **Aim 3**: Estimate the added healthcare costs and utilization associated with ED and ED subtypes.

- **What was accomplished under these goals?**

  - *For this reporting period describe: 1) major activities; 2) specific objectives; 3) significant results or key outcomes, including major findings, developments, or conclusions (both positive and negative); and/or 4) other achievements. Include a discussion of stated goals not met. Description shall include pertinent data and graphs in sufficient detail to explain any significant results achieved. A succinct description of the methodology used shall be provided. As the project progresses to completion, the emphasis in reporting in this section should shift from reporting activities to reporting accomplishments.*

  - Expanding on work from year 1, in year 2 we conducted a series of preliminary analyses of a sample of veterans with a diagnosis of eating disorders, which we described by type of disorder, time of diagnosis, gender, age, and BMI.
  - We assembled and trained a chart review team (VA clinical psychologists with expertise in the assessment and treatment of eating disorders in veterans). We completed the first phase of chart review validation which involved calibrating ratings across reviewers and establishing criteria for classifying ED cases, possible cases, and non-ED cases.
  - We developed a comprehensive chart review guide led by Dr Kelly Harrington and her team, which describes in detail the data elements to be reviewed (e.g., diagnoses, sudden changes in weight, medications, procedures, and other) and describes how to conduct the reviews electronically. This review guide will eventually be made public and could be used in the future for similar work relying on chart reviews.

- The guide is used by chart reviewers currently and we expect to be able to complete the chart review validation and finalize the EHR algorithm in the next few months, and then implement it in order to identify ED on the aggregate and by subtypes.
- In addition to pulling and cleaning structured data elements (e.g., diagnostic codes, procedures, labs, medications, etc.), we also made significant progress in curating unstructured data elements (clinical notes) for inclusion in the ED algorithm model. Specifically, we have nearly finalized an extensive dictionary of ED-related terms/concepts and created a natural language processing (NLP) pipeline for identifying/extracting relevant snippets of clinical notes from the VA electronic health record.
- We made progress towards Aims 2 and 3, by completing analysis plans that provide step-by-step directions for the data sources, merging, design, variable creation and statistical methods. These were accomplished through regular discussions with data analysts and members of the team with expertise in VA cost data, and preliminary explorations of specific VA data elements. This process allowed us to move closer towards being able to operationalize our population, comparison groups, and variables of interest, including utilization by healthcare setting (emergency department, inpatient, outpatient, pharmacy), by payer (VA vs Medicaid/Medicare), and by year.

- We conducted a preliminary literature review on costing methods and on published research of costs associated with ED and select comorbidities to inform the direction and scope of the peer-reviewed papers that will be written after completion of Aim 3. Some of the main papers that our team plans to publish include a methodological paper describing the algorithm for ED identification and two papers for Aim 3 with tentative titles “Healthcare resource utilization and costs among military veterans with ED: a longitudinal analysis” and “Clinical and economic burden of medical comorbidities among military veterans with eating disorders.”
- A preliminary exploration of the distributions of key characteristics of the initial study cohort of veterans with ED (N = 33,292) from 1999 through 2021 showed the following:
  - Among veterans with one or more ED diagnoses in the VA EHR, the most prevalent subtype is Eating Disorder Not Otherwise Specified* (57.1%), followed by Bulimia Nervosa (16.0%), Binge Eating Disorder (11.7%), and Anorexia Nervosa (11.7%).
  - Women account for 42% of all VHA veterans with an ED diagnosis.
  - The proportion of men with an EDNOS diagnosis is higher than the respective proportion of women (62.5% vs. 49.7%). The proportion of women with a Bulimia Nervosa diagnosis is much higher than the respective proportion of men (26.3% vs. 8.6%). The proportion of other ED subtypes looked quite comparable between women and men.
  - The rate of ED diagnosis in VHA veterans increased significantly over the period examined. Between 2010 and 2020, the number of new ED diagnoses increased by 123% for men and 159% for women, respectively.
    *Note: The following diagnosis codes were included in the ED NOS category: Eating disorder, unspecified; Other eating disorders; Other specified feeding and eating disorder (OSFED).

- **What opportunities for training and professional development has the project provided?**

  - *If the project was not intended to provide training and professional development opportunities or there is nothing significant to report during this reporting period, state "Nothing to Report."*

  - Nothing to Report

  - *Describe opportunities for training and professional development provided to anyone who worked on the project or anyone who was involved in the activities supported by the project. "Training" activities are those in which individuals with advanced professional skills and experience assist others in attaining greater proficiency. Training activities may include, for example, courses or one-on-one work with a mentor. "Professional development" activities result in increased knowledge or skill in one's area of*

expertise and may include workshops, conferences, seminars, study groups, and individual study. Include participation in conferences, workshops, and seminars not listed under major activities.

- **How were the results disseminated to communities of interest?**
  - *If there is nothing significant to report during this reporting period, state "Nothing to Report." Nothing to report*
  - Nothing to Report
  - *Describe how the results were disseminated to communities of interest. Include any outreach activities that were undertaken to reach members of communities who are not usually aware of these project activities, for the purpose of enhancing public understanding and increasing interest in learning and careers in science, technology, and the humanities.*
- **What do you plan to do during the next reporting period to accomplish the goals?**
  - *If this is the final report, state "Nothing to Report."*
  - *Describe briefly what you plan to do during the next reporting period to accomplish the goals and objectives.*
  - We are continuing to develop our EHR-based algorithm. Once developed, we will evaluate its performance relative to chart review diagnosis gold standard. Simultaneously, we will initiate analyses of health care costs attributable to eating disorders.

4. **IMPACT:** *Describe distinctive contributions, major accomplishments, innovations, successes, or any change in practice or behavior that has come about as a result of the project relative to:*
   - **What was the impact on the development of the principal discipline(s) of the project?**
     - *If there is nothing significant to report during this reporting period, state "Nothing to Report."*
     - Nothing to Report
     - *Describe how findings, results, techniques that were developed or extended, or other products from the project made an impact or are likely to make an impact on the base of knowledge, theory, and research in the principal disciplinary field(s) of the project. Summarize using language that an intelligent lay audience can understand (Scientific American style).*
   - **What was the impact on other disciplines?**
     - *If there is nothing significant to report during this reporting period, state "Nothing to Report."*
     - Nothing to Report
     - *Describe how the findings, results, or techniques that were developed or improved, or other products from the project made an impact or are likely to make an impact on other disciplines.*
   - **What was the impact on technology transfer?**
     - *If there is nothing significant to report during this reporting period, state "Nothing to Report."*
     - Nothing to Report
     - *Describe ways in which the project made an impact, or is likely to make an impact, on commercial technology or public use, including:*
       - *transfer of results to entities in government or industry;*
       - *instances where the research has led to the initiation of a start-up company; or*
       - *adoption of new practices.*
   - **What was the impact on society beyond science and technology?**

- *If there is nothing significant to report during this reporting period, state "Nothing to Report."*
- Nothing to Report
- *Describe how results from the project made an impact, or are likely to make an impact, beyond the bounds of science, engineering, and the academic world on areas such as:*
  - *improving public knowledge, attitudes, skills, and abilities;*
  - *changing behavior, practices, decision making, policies (including regulatory policies), or social actions; or*
  - *improving social, economic, civic, or environmental conditions.*

5. **CHANGES/PROBLEMS:** *The Project Director/Principal Investigator (PD/PI) is reminded that the recipient organization is required to obtain prior written approval from the awarding agency Grants Officer whenever there are significant changes in the project or its direction. If not previously reported in writing, provide the following additional information or state, "Nothing to Report," if applicable:*
   - **Changes in approach and reasons for change**
     - *Describe any changes in approach during the reporting period and reasons for these changes. Remember that significant changes in objectives and scope require prior approval of the agency.*
     - Nothing to Report
   - **Actual or anticipated problems or delays and actions or plans to resolve them**
     - *Describe problems or delays encountered during the reporting period and actions or plans to resolve them.*
     - Nothing to Report
   - **Changes that had a significant impact on expenditures**
     - *Describe changes during the reporting period that may have had a significant impact on expenditures, for example, delays in hiring staff or favorable developments that enable meeting objectives at less cost than anticipated.*
     - Nothing to Report
   - **Significant changes in use or care of human subjects, vertebrate animals, biohazards, and/or select agents**
     - *Describe significant deviations, unexpected outcomes, or changes in approved protocols for the use or care of human subjects, vertebrate animals, biohazards, and/or select agents during the reporting period. If required, were these changes approved by the applicable institution committee (or equivalent) and reported to the agency? Also specify the applicable Institutional Review Board/Institutional Animal Care and Use Committee approval dates.*
     - Nothing to Report
   - **Significant changes in use or care of human subjects**
     - Nothing to Report
   - **Significant changes in use or care of vertebrate animals.**
     - Nothing to Report
   - **Significant changes in use of biohazards and/or select agents**
     - Nothing to Report

6. **PRODUCTS:** *List any products resulting from the project during the reporting period. If there is nothing to report under a particular item, state "Nothing to Report."* Nothing to report (?)

- **Publications, conference papers, and presentations**
  Report only the major publication(s) resulting from the work under this award.

  - **Journal publications.** *List peer-reviewed articles or papers appearing in scientific, technical, or professional journals. Identify for each publication: Author(s); title; journal; volume: year; page numbers; status of publication (published; accepted, awaiting publication; submitted, under review; other); acknowledgement of federal support (yes/no).*

    - Nothing to Report

  - **Books or other non-periodical, one-time publications.** *Report any book, monograph, dissertation, abstract, or the like published as or in a separate publication, rather than a periodical or series. Include any significant publication in the proceedings of a one-time conference or in the report of a one-time study, commission, or the like. Identify for each one-time publication: Author(s); title; editor; title of collection, if applicable; bibliographic information; year; type of publication (e.g., book, thesis or dissertation); status of publication (published; accepted, awaiting publication; submitted, under review; other); acknowledgement of federal support (yes/no).*

    - Nothing to Report

  - **Other publications, conference papers, and presentations.** *Identify any other publications, conference papers and/or presentations not reported above. Specify the status of the publication as noted above. List presentations made during the last year (international, national, local societies, military meetings, etc.). Use an asterisk (*) if presentation produced a manuscript.*

    - Nothing to Report

- **Website(s) or other Internet site(s)**
  List the URL for any Internet site(s) that disseminates the results of the research activities. A short description of each site should be provided. It is not necessary to include the publications already specified above in this section.

  - Nothing to Report

- **Technologies or techniques**
  Identify technologies or techniques that resulted from the research activities. In addition to a description of the technologies or techniques, describe how they will be shared.

  - Nothing to Report

- **Inventions, patent applications, and/or licenses**
  Identify inventions, patent applications with date, and/or licenses that have resulted from the research. State whether an application is provisional or non-provisional and indicate the application number. Submission of this information as part of an interim research performance progress report is not a substitute for any other invention reporting required under the terms and conditions of an award.

  - Nothing to Report

- **Other Products**
  Identify any other reportable outcomes that were developed under this project. Reportable outcomes are defined as a research result that is or relates to a product, scientific advance, or research tool that makes a meaningful contribution toward the understanding, prevention, diagnosis, prognosis, treatment, and/or rehabilitation of a disease, injury or condition, or to improve the quality of life. Examples include:

  - *data or databases;*
  - *biospecimen collections;*
  - *audio or video products;*
  - *software;*
  - *models;*
  - *educational aids or curricula;*

- *instruments or equipment;*
- *research material (e.g., Germplasm; cell lines, DNA probes, animal models);*
- *clinical interventions;*
- *new business creation; and*
- *other.*
    - Nothing to Report

7. **PARTICIPANTS & OTHER COLLABORATING ORGANIZATIONS**

- **What individuals have worked on the project?**
    - *Provide the following information for: (1) PDs/PIs; and (2) each person who has worked at least one person month per year on the project during the reporting period, regardless of the source of compensation (a person month equals approximately 160 hours of effort). If information is unchanged from a previous submission, provide the name only and indicate "no change."*

Name:	Dr. Mihail Samnaliev- no change
Name:	Dr. Bryn Austin- no change
Name:	Dr. Kelly Harrington- no change
Name:	Dr. Kelly Cho- no change
Name:	Dr. Karen Mitchell- no change
Name:	Dr. David Gagnon- no change
Name:	Sherry Lin- no change

- **Has there been a change in the active other support of the PD/PI(s) or senior/key personnel since the last reporting period?**
    - *If there is nothing significant to report during this reporting period, state "Nothing to Report." Nothing to report*
    - Nothing to Report
    - *If the active support has changed for the PD/PI(s) or senior/key personnel, then describe what the change has been. Changes may occur, for example, if a previously active grant has closed and/or if a previously pending grant is now active. Annotate this information so it is clear what has changed from the previous submission. Submission of other support information is not necessary for pending changes or for changes in the level of effort for active support reported previously. The awarding agency may require prior written approval if a change in active other support significantly impacts the effort on the project that is the subject of the project report.*
- **What other organizations were involved as partners?**
    - *If there is nothing significant to report during this reporting period, state "Nothing to Report."*
    - *Describe partner organizations - academic institutions, other nonprofits, industrial or commercial firms, state or local governments, schools or school systems, or other organizations (foreign or domestic) - that were involved with the project. Partner organizations may have provided financial or in-kind support, supplied facilities or equipment, collaborated in the research, exchanged personnel, or otherwise contributed.*
      Provide the following information for each partnership:
        - **Organization Name:** Boston VA Research Institute (BVARI)/Massachusetts Veterans Epidemiology Research and Information Center (MAVERIC)

- **Location of Organization:** *(if foreign location list country)* Boston, Massachusetts
- **Partner's contribution to the projec**t *(identify one or more)*
  - **Financial support:** Dept. of Defense
  - **In-kind support** *(e.g., partner makes software, computers, equipment, etc., available to project staff)*: None
  - **Facilities** *(e.g., project staff use the partner's facilities for project activities)*: Massachusetts Veterans Epidemiology Research and Information Center (MAVERIC) is an interdisciplinary research and development organization with the goal of creating a learning healthcare system within VA through application of research resources and methodologies to important clinical problems. Toward this end, MAVERIC combines resources from each of its core competencies.
  - **Collaboration** *(e.g., partner's staff work with project staff on the project)*: Personnel with MAVERIC at the Boston VA site jointly with Dr. Austin and Dr. Samnaliev develop plans for analyses to address specific aims, providing direction for data programming with input from co-investigators and consultants. In addition, data analyses are carried out on site at the Boston VA. Collaboration will be ensured through regularly scheduled in-person meetings occurring every two weeks at minimum.
  - **Personnel exchanges** *(e.g., project staff and/or partner's staff use each other's facilities, work at each other's site)*: Dr. Samnaliev can carry out work at Boston Children's Hospital and at the Boston VA.
  - **Other:** NA
- **Organization Name:** Western Institute for Veteran's Research formerly known as Western Institute for Biomedical Research. (This site was included in BVARI's budget and BCH issued and is managing the award for more effect monitoring.) In 2021, the site changed its name to more accurately reflect its mission. No further changes to organization information.
- **Location of Organization:** *(if foreign location list country)* Salt Lake City, Utah
- **Partner's contribution to the projec**t *(identify one or more)*
  - **Financial support:** Dept. of Defense
  - **In-kind support** *(e.g., partner makes software, computers, equipment, etc., available to project staff)*: None
  - **Facilities** *(e.g., project staff use the partner's facilities for project activities)*: Western Institute for Biomedical Research is a nonprofit corporation established in 1989 to promote research and related educational activities at the VA Salt Lake City Health Care System,
  - **Collaboration** *(e.g., partner's staff work with project staff on the project)*: Dr. Nelson provides guidance in dataset construction and analysis to estimate the healthcare costs associated with eating disorders. Collaboration will be ensured through regularly scheduled in-person meetings occurring every two weeks at minimum.
  - **Personnel exchanges** *(e.g., project staff and/or partner's staff use each other's facilities, work at each other's site)*: N/A

- **Other:** NA

8. **SPECIAL REPORTING REQUIREMENTS**

   - **COLLABORATIVE AWARDS:** *For collaborative awards, independent reports are required from **BOTH** the Initiating PI and the Collaborating/Partnering PI. A duplicative report is acceptable; however, tasks shall be clearly marked with the responsible PI and research site. A report shall be submitted to https://ebrap.org for each unique award.*

   - **QUAD CHARTS:** *If applicable, the Quad Chart (available on https://www.usamraa.army.mil) should be updated and submitted with attachments.*

9. **APPENDICES:** *Attach all appendices that contain information that supplements, clarifies or supports the text. Examples include original copies of journal articles, reprints of manuscripts and abstracts, a curriculum vitae, patent applications, study questionnaires, and surveys, etc. Reminder: Pages shall be consecutively numbered throughout the report. **DO NOT RENUMBER PAGES IN THE APPENDICES.***

Background: Eating disorders (ED), including anorexia nervosa, bulimia nervosa, and binge eating disorder, are serious illnesses that lead to disturbance in one's eating behaviors and can result in poorer health, lower quality of life, and long-term expensive treatment. About 30 million Americans at some point in their lifetimes will have an ED. Individuals with ED often suffer from substance use disorders and other mental health problems, including anxiety and depression. However, very little is known about the prevalence of ED and the patterns of co-occurring mental health and substance use problems among military Veterans. Researchers are beginning to recognize that additional evidence of the prevalence, patterns of co-occurring illness, and costs of ED among Veterans is needed to accurately evaluate the overall burden of disease and to design effective ED screening and treatment programs.

Research Plan: We will address several critical questions identified in the Department of Defense FY18 Peer Reviewed Medical Research Program (PRMRP) Area of Encouragement of eating disorders. 1) Using the largest and most comprehensive database of US military Veterans, we will generate precise estimates of ED prevalence (% of Veterans with ED within a year) and incidence (new cases by year) among Veterans in the aggregate. We will also estimate ED prevalence/incidence by sociodemographic groups, including by age, gender, race/ethnicity, obesity status, and age cohort. 2) Our study will document patterns of co-occurring mental health and substance use problems among Veterans with ED. These disorders affect military Veterans at disproportionately high rates compared to the general population but are often left untreated resulting in unnecessary health burden and excess costs of care. We will evaluate whether such co-occurring problems precede (and may lead to) ED or if they develop subsequently to an ED episode (and may be caused in part by ED). This information can be used by medical providers to develop effective screening and treatment programs for Veterans with ED based on the progression of the disease and co-occurring illnesses. 3) Our study will document the added utilization and cost of care to the Veterans Health Administration (VHA) associated with ED, which can be used by policymakers to evaluate the burden of disease to the VHA and in future evaluations of the cost-effectiveness of ED prevention and treatment.

Impact: Our study has the potential for an unprecedented impact on the health and quality of life among Veterans with the condition. We will produce the most accurate estimates to date of the scope and impact of ED on Veterans' health as a whole and in high-risk subgroups, changes in incidence over time and with age, and the health services and cost burden posed by ED for the VHA, in addition to Medicare. Through better detection of ED and through better understanding of the co-occurring illnesses among those with ED, our research can directly help medical providers assess risk of developing ED and mental health and substance use disorders, which will have a significant beneficial impact on the health, wellbeing, and quality of life of Veterans. Findings from this study will likely lead to several profound benefits for Veterans and the larger general population by informing the development of: 1) More accurate screening tools for use in large EHR databases to identify undiagnosed eating disorders cases in healthcare samples; 2) Indicators for early identification of emerging eating disorders symptoms to enable early intervention when treatments are known to be most effective to prevent onset of full-blown disorder; and 3) Effective models of care for integrated treatment of ED and co-occurring mental health and substance use disorders.