QUERI

Evidence Review: Social Determinants of Health for Veterans

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PREFACE

The VA Evidence-based Synthesis Program (ESP) was established in 2007 to provide timely and accurate syntheses of targeted healthcare topics of particular importance to clinicians, managers, and policymakers as they work to improve the health and healthcare of Veterans. QUERI provides funding for four ESP Centers, and each Center has an active University affiliation. Center Directors are recognized leaders in the field of evidence synthesis with close ties to the AHRQ Evidence-based Practice Centers. The ESP is governed by a Steering Committee comprised of participants from VHA Policy, Program, and Operations Offices, VISN leadership, field-based investigators, and others as designated appropriate by QUERI/HSR&D.

The ESP Centers generate evidence syntheses on important clinical practice topics. These reports help:

- Develop clinical policies informed by evidence;
- Implement effective services to improve patient outcomes and to support VA clinical practice guidelines and performance measures; and
- Set the direction for future research to address gaps in clinical knowledge.

The ESP disseminates these reports throughout VA and in the published literature; some evidence syntheses have informed the clinical guidelines of large professional organizations.

The ESP Coordinating Center (ESP CC), located in Portland, Oregon, was created in 2009 to expand the capacity of QUERI/HSR&D and is charged with oversight of national ESP program operations, program development and evaluation, and dissemination efforts. The ESP CC establishes standard operating procedures for the production of evidence synthesis reports; facilitates a national topic nomination, prioritization, and selection process; manages the research portfolio of each Center; facilitates editorial review processes; ensures methodological consistency and quality of products; produces “rapid response evidence briefs” at the request of VHA senior leadership; collaborates with HSR&D Center for Information Dissemination and Education Resources (CIDER) to develop a national dissemination strategy for all ESP products; and interfaces with stakeholders to effectively engage the program.

Comments on this evidence report are welcome and can be sent to Nicole Floyd, ESP CC Program Manager, at Nicole.Floyd@va.gov.

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EXECUTIVE SUMMARY

INTRODUCTION

Social determinants of health usually refer to factors that are socially constructed and/or impact health through socio-cultural mechanisms. Social determinants are responsible for much variation in health outcomes, especially when considered together with their linked environmental exposures and health behaviors. Indeed, seminal work on social determinants of health demonstrated that they are potent factors in predicting health disparities, with the disadvantaged suffering the worst outcomes. Understanding the role of social determinants in the health of Veterans, and identifying clinical and research opportunities to impact the pathways between social determinants and health, are critical for the VHA's mission to serve and improve health outcomes for all Veterans.

Taken as a whole, social determinants substantially influence health outcomes and contribute to health disparities. The VHA Office of Patient Care Services—Population Health Services and Office of Rural Health (hereafter, VHA partners) requested an evidence review to examine social determinants of Veterans' health, particularly as to those social determinants which may be more important for Veterans' health outcomes (or for certain Veteran groups), as compared with non-Veterans. The goal for this evidence review was to guide VHA planning for health care services that may be influenced by, or should be targeted to, social determinants contributing to poorer health and greater care needs among Veterans. In collaboration with our VHA partners, we developed the scope and conceptual framework for the evidence review, with the focus being social determinants that may be differentially important for Veterans compared with non-Veterans, or between Veterans enrolled in or utilizing certain VHA services, compared with those Veterans who did not. We engaged our VHA partners in a prioritization process after developing an initial evidence map, and selected those social determinants which would undergo more detailed review and reporting of published results (*ie*, rurality, trauma history, sexual orientation and gender identity).

In accordance with a conceptual framework developed for this review we addressed the following key questions:

Key Question 1: How do ***Veterans*** compare to ***non-Veterans*** in prevalence and characteristics of social determinants of health?

Key Question 2: Does variation in social determinants of health account for differences in health services access, health-related behaviors, and health outcomes between Veterans and non-Veterans?

Key Question 3: How do ***engaged*** (*ie*, enrolled in or utilizing categories of VHA services or benefits) Veterans compare to ***non-engaged*** (*ie*, not enrolled in or utilizing VHA services or benefits) Veterans in prevalence and characteristics of social determinants of health?

Key Question 4: Does variation in social determinants of health account for differences in health services access, health-related behaviors, and health outcomes between engaged Veterans and non-engaged Veterans?

In Key Questions 3 and 4 we use the terms “engaged” and “non-engaged” to describe groups of Veterans differing by enrollment in VHA or other VA benefits and services, or utilization of categories of VHA services (*eg*, mental health or other specialty care).

METHODS

Development of Conceptual and Analytic Frameworks

We developed a conceptual framework that depicts the complex relationships between social determinants of health, Veteran status or experiences, and health outcomes, drawing upon work from multiple sources. We sought to be inclusive and broad in conceptualizing relevant social determinants, but also considered whether specific social determinants have available measures, and whether they were high priority for national groups and our VHA partners. Using our conceptual framework, we developed 2 analytic frameworks to help identify the populations of interest, highlight social determinants that are likely relevant, define outcomes of interest, and determine the inclusion/exclusion criteria for the evidence review.

Data Sources and Searches

We undertook a multi-faceted approach to identifying published articles. First, we searched MEDLINE (OVID), the Cumulative Index to Nursing and Allied Health Literature (CINAHL), PsycINFO, and Sociological Abstracts, from the date of inception for each database to January 2017, for English language publications. We added references suggested by experts and peer reviewers. We examined publications associated with multiple large national cohorts (*eg*, American Community Survey, Behavioral Risk Factor Surveillance System), and some VA research programs. We reviewed whether database search results included articles that used data from these cohorts. Then, we screened additional citations/abstracts and reports that were associated with these cohorts, as indicated by publication lists, bibliographies, or other available information. We thought it unlikely that randomized controlled trials or controlled clinical trials would address our key questions regarding the social determinants of health, but for completeness, we undertook an expedited review of citations/abstracts found through a repeat MEDLINE search limiting the search to “trials” instead of other study designs.

Study Selection

Two investigators independently reviewed titles and abstracts from the literature searches. Citations/abstracts identified as potentially eligible by at least one reviewer underwent dual-review of the full-texts. Discrepancies between reviewers at the full-text review stage were resolved by discussion or a third reviewer. For the expedited review of trials, one investigator screened abstracts and 2 investigators reviewed the full texts of potentially eligible articles.

Our inclusion and exclusion criteria were as follows:

Inclusion:

1. Includes data on:
    a. US Veterans and non-Veterans and/or
    b. US Veterans engaged and not engaged in VHA services or benefits

2. Includes at least one social determinant of interest (*ie*, employment, education, income, family/social support, past trauma experience, rural residence, gender identity, or sexual orientation).

Exclusion

1. Fewer than 100 participants
2. Does not report prevalence, degree, levels, or characteristics of social determinants by population of interest (*ie*, Veteran/non-Veteran, engaged/non-engaged Veterans)
3. Not study design of interest (*eg*, narrative review, case report, editorial/viewpoint)

Data Abstraction and Quality Assessment

For all included articles, we abstracted study characteristics (*eg*, cross-sectional or cohort design), social determinants addressed, and whether the article examined the role of social determinants in health services access or utilization, health behaviors (*eg*, substance use), or health outcomes of interest (*eg*, mental health conditions, disability). For articles which investigated one of 3 high-priority social determinants (**rurality, trauma, and sexual orientation or gender identity**), we further abstracted the data source (*eg*, NHANES), participant number and demographics, measures of social determinant(s), and the prevalence, degree, or level of social determinant(s) for the groups of interest (*ie*, either Veterans and non-Veterans or engaged and non-engaged Veterans). If articles examined the role of social determinants in health services access, health-related behaviors, and/or health outcomes, we also abstracted methods and results from these analyses. Data abstraction was completed by one reviewer with verification by a second, with discrepancies resolved by discussion.

We performed dual-reviewer quality assessment for included articles which addressed the 3 high-priority social determinants. We considered the following elements related to study quality:

1. Representativeness and coverage (*ie*, source of data [*eg*, nationally representative cohort], recruitment and selection of participants, concerns about missing data);
2. Measurement (*ie*, social determinants assessed in similar manner for groups being compared and using standardized measures; health-related behavior, health services access, and health outcomes assessed in similar manner for groups being compared and using standardized measures); and
3. Funding source.

Each reviewer independently rated the study quality based on prevalence assessment (Key Questions 1 and 3) and examining the role of social determinants in health services access, health behaviors, or health outcomes (Key Questions 2 and 4). Discrepancies were resolved by discussion.

Data Synthesis and Analysis

We provide 2 separate evidence maps of included articles which addressed social determinants for Veterans and non-Veterans (Key Questions 1 and 2), and for Veterans engaged and not engaged in VA services and benefits (Key Questions 3 and 4). For articles examining the 3 high-priority social determinants, we undertook qualitative syntheses and assessed overall strength of evidence.

RESULTS

Results of Literature Search

We screened 7,242 abstracts and excluded 6,792 yielding 450 articles for full-text review. We added 6 articles from the search of clinical trials, recommendations from experts, and our review of national cohorts and VA research programs. We included 131 articles.

Summary of Results for Key Questions

Key Questions 1 and 2:

*How do **Veterans** compare to **non-Veterans** in prevalence and characteristics of social determinants of health?*

Does variation in social determinants of health account for differences in health services access, health-related behaviors, and health outcomes between Veterans and non-Veterans?

Evidence Map: We identified 99 articles which addressed at least one social determinant of interest for Veterans and non-Veterans. Most articles used cross-sectional data and included over 1000 participants. Education, marital status, income, and employment were addressed by the greatest number of articles, and some of these articles examined the role of these social determinants in health behaviors, health services access or utilization, and/or health outcomes. In contrast, other social determinants were addressed by far fewer articles, and several social determinants were not examined by any articles which considered health behaviors, or health services access or utilization.

Qualititative Synthesis of Results for Rurality, Trauma, and Sexual Orientation and Gender Identity: We identified 11 articles which examined rurality, 11 which addressed trauma, and 2 on sexual orientation for Veterans and non-Veterans. We found no articles comparing the prevalence or health effects of gender identity for Veterans and non-Veterans. Most articles on rurality, trauma, and/or sexual orientation used nationally representative datasets, included more than 5000 participants, and were rated low or medium quality. One-third of articles included data on only men, and 5 had only women participants. Half of the articles investigated the role of rurality, trauma, and/or sexual orientation in health behaviors, health services access or utilization, or various health outcomes.

We identified the following key messages from these articles:

1. There are no substantial differences in proportions of Veterans and non-Veterans who lived in rural settings. Most articles used nationally representative data and were consistent in their results, but rurality definitions varied widely, thus limiting interpretations. (Moderate strength evidence)

2. We found insufficient evidence on the effects of rurality on health services utilization, health behaviors, or health outcomes between Veterans and non-Veterans.

3. There is higher prevalence of trauma exposure among Veterans, compared with non-Veterans. Half of articles used nationally representative data, results were somewhat inconsistent, and trauma types and measures varied across articles. (Low strength of evidence)

4. We found insufficient evidence on whether prevalence differences exist in minority sexual orientation between Veterans and non-Veterans.

5. We found insufficient evidence that sexual minority status accounts for mortality differences between Veteran and non-Veteran women.

6. No included articles addressed gender identity in comparing Veterans and non-Veterans.

Key Questions 3 and 4:

*How do **engaged** Veterans compare to **non-engaged** Veterans in prevalence and characteristics of social determinants of health?*

Does variation in social determinants of health account for differences in health services access, health-related behaviors, and health outcomes between engaged Veterans and non-engaged Veterans?

Evidence Map: Forty included articles examined social determinants of interest for Veterans engaged and not engaged in VHA services and/or benefits. Most articles used cross-sectional data; education, marital status, income, and employment were the most frequently included determinants. Fewer articles examined the role of social determinants in health behaviors, health services access or utilization, and/or health outcomes. Several of the social determinants were examined in fewer than 10 articles, including trauma exposure, social support, and housing status. We identified no studies examining sexual orientation or financial barriers to health care.

Rurality, Trauma, and Sexual Orientation and Gender Identity: We included 14 articles which examined rurality, 6 which addressed trauma, and none for sexual orientation or gender identity. Most articles on rurality and/or trauma used nationally representative datasets. While most articles on rurality included more than 5000 participants and included both men and women, most articles on trauma had 1000 or fewer participants and 4 included only women. Two articles investigated the role of rurality on health services access or utilization, and/or various health outcomes; no rurality articles examined health behaviors. No articles addressed the role of trauma exposure in health services utilization, health behaviors, or health outcomes of interest.

We identified the following key messages from these articles:

1. There were no substantial differences in rurality between engaged and non-engaged Veterans, but for Veterans using certain specific services (*eg*, VHA homeless services), there may be differences in proportion with rural residence. (Moderate strength evidence)

2. We found insufficient evidence on the effects of rurality on differences in health services utilization, health behaviors, or health outcomes between engaged and non-engaged Veterans.

3. Trauma exposure is higher for Veterans engaged versus not engaged in VHA care. (Low strength of evidence).

4. No articles addressed the role of trauma exposure in differences in health services access, health behaviors, or health outcomes between engaged and non-engaged Veterans.

5. No articles investigated sexual orientation or gender identity among engaged and non-engaged Veterans.

DISCUSSION

Key Findings

Evidence Maps

Most included articles examined standard sociodemographics, such as education, marital status, income, and employment. Fewer articles addressed other social determinants, including those that were high priority for our VHA partners.

Rurality

We found moderate strength evidence that there are no substantial differences in rurality between Veterans and non-Veterans or engaged and non-engaged Veterans. Included articles reported consistent results regarding lack of differences, but there was wide variation in the definition of rurality, limiting interpretations. We found insufficient evidence on the effects of rurality on differences in health services utilization, health behaviors, or health outcomes between Veterans and non-Veterans or engaged and non-engaged Veterans.

Trauma

We found low strength of evidence that there is increased trauma exposure among Veterans as compared with non-Veterans, and among engaged Veterans compared with non-engaged Veterans. We found low strength evidence that trauma exposure contributes to differences in prevalence of smoking between Veterans and non-Veterans. We identified no articles that addressed the role of trauma exposure in health services access, health behaviors, or health outcomes between engaged and non-engaged Veterans. Included articles on trauma examined a wide variety of exposures, including type, timing, and measures used.

Sexual Orientation or Gender Identity

We found insufficient evidence regarding differences in prevalence of sexual minority between Veterans and non-Veterans. Only 2 articles examined sexual orientation for Veterans and non-Veterans and included only women. We found no articles that addressed gender identity for our groups of interest.

Applicability and Implications for Policy and Practice

Our evidence review directly contributes to several essential strategies for improving VHA services and enhancing Veteran health, as outlined in the Blueprint for Excellence. The evidence base for social determinants of Veterans' health mainly addresses classic socioeconomic factors, with a clear lack of evidence about more recently developed and conceptualized social determinants, such as trauma exposures, sexual orientation, and gender identity. This evidence review supports the development and implementation of consistent, accurate measures of these social determinants for Veterans. This would enable future work to understand the effects of social determinants on health behaviors, health services utilization, and health outcomes for Veterans.

In areas where we did not identify sufficient evidence for the role of social determinants in Veterans' health, our evidence review provides indirect support for policies that apply knowledge of the effects of these social determinants in the general US population. In contrast, we found evidence that trauma exposures may be different between Veterans and non-Veterans, and between engaged and non-engaged Veterans, suggesting that understanding the impacts of trauma on health care utilization and outcomes could help inform VHA policies for current and future service needs. This also highlights the importance of establishing consistent, accurate, and meaningful measures of trauma exposure in VHA data systems, in order to improve outcomes for Veterans now and in the future.

Research Gaps/Future Research

This evidence review represents an extensive and thorough examination of available sources of evidence to address the role of a variety of social determinants. This work enables future evaluations and syntheses of the evidence supporting the role of social determinants in health, beyond the 3 high-priority determinants that were examined in detail. This evidence review also identified major gaps in the evidence, including the lack of articles that addressed certain social determinants, such as gender identity. This evidence gap is even greater with regard to the role of social determinants in health care access, health behaviors, and health outcomes. Some of the areas lacking in evidence would greatly benefit from inclusion of consistent measures of social determinants and military experience. One way to address this would be to promote the addition of assessments for certain social determinants (*eg*, sexual orientation) to existing national studies that already collect information about Veterans (*eg*, American Community Surveys). We also need data sources that provide information on social determinants and non-VHA health care access and utilization for both engaged and non-engaged Veterans.

In addition to the major gaps related to lack of existing data, our evidence review brought to light several challenges to understanding the role of social determinants. These include the fact that social determinants may represent dimensions along which there is differential selection of individuals into military experience as well as the dynamic, often bidirectional nature of relationships between social determinants, Veteran experiences, and health over the life course. Use of clear conceptual frameworks in future studies will be critical. To support such work, we need multidisciplinary teams that include content and methodologic experts in the diversity of social determinants, as well as investigators with experience in clinical, operational, and policy settings.

Summary of major research gaps and recommendations:

- Promote inclusion of consistent and accurate assessments of high-priority social determinants (*eg*, trauma exposures, sexual orientation) in existing or ongoing national datasets that also capture Veteran status.

- Develop new data sources and/or improve ability to link with existing non-VHA data sources, to address social determinants and outcomes for Veterans engaged and not engaged in VHA services or benefits.

- Apply measures of social determinants more consistently and, whenever possible, provide sufficient detail to address how social determinants may be affecting outcomes.

- Develop and utilize clear conceptual frameworks that guide analytic decisions and interpretation of results.

Conclusions

While extensive literature addresses education, marital status, income, and/or employment, little published work exists on other social determinants of health (*eg*, trauma and sexual orientation). We found no differences in rural residence between Veterans and non-Veterans, and between engaged and non-engaged Veterans. Trauma exposure among Veterans was generally higher in engaged vs non-engaged Veterans. We found insufficient evidence to determine if there are differences in sexual orientation or gender identity between Veterans and non-Veterans or between engaged and non-engaged Veterans. Social determinant knowledge gaps could be addressed by clear conceptual frameworks and innovative analytic strategies, even with cross-sectional data. Direct standardized measurement of key community characteristics of rural settings and focused assessment of specific types of trauma may be more informative for defining pathways that could be targeted for improving the health of Veterans.

ABBREVIATIONS TABLE

95% CI	95% confidence interval
ACEs	Adverse Childhood Experiences Survey
BRFSS	Behavioral Risk Factor Surveillance System
CINAHL	Cumulative Index to Nursing and Allied Health Literature
HR	Hazard ratio
IPV	Intimate partner violence
MSA	Metropolitan Statistical Areas
NHANES	National Health and Nutrition Examination Survey
NHIS	National Health Interview Survey
OIF/OEF	Operation Iraqi Freedom/Operation Enduring Freedom
OR	Odds ratio
PICO	Population; Intervention; Comparator; Outcome
RCT	Randomized controlled trial
RUC	Rural-Urban Continuum
RUCA	Rural-Urban Commuting Area
VA	Department of Veterans Affairs
VHA	Veterans Health Administration
WHI	Women's Health Initiative

EVIDENCE REPORT

INTRODUCTION

Social determinants of health are broad and often defined in the context of other factors that also impact health. For example, the Institute of Medicine's (IOM) report, *Capturing Social and Behavioral Domains and Measures in Electronic Health Records*, defined social determinants as "sociocultural, socio-economic, and socio-demographic status; biosocial interactions; and the various levels of social context…"[1] This IOM report differentiated social from behavioral factors in that the latter indicate observable actions, underlying cognitions, and/or other related psychological constructs. Similarly, Tarlov's framework posited "social and societal characteristics" as one of 5 major categories of determinants of population health, with the others being genes and biology, health behaviors, medical care, and the "ecology of all living things."[2] Although exact definitions vary somewhat, there is consensus that social determinants include many distinct concepts, and taken as a whole, they substantially influence health outcomes and contribute to health disparities.[2,3,4-6]

The VHA Office of Patient Care Services—Population Health Services and Office of Rural Health (hereafter, VHA partners) requested an evidence review to examine social determinants of Veterans' health, particularly as to those social determinants which may be more important for Veterans' health outcomes (or for certain Veteran groups), as compared with non-Veterans. The goal for this evidence review was to guide VHA planning for health care services that may be influenced by, or should be targeted to social determinants contributing to poorer health and greater care needs among Veterans. In collaboration with our VHA partners, we developed the scope and conceptual framework for an evidence map, with the focus being social determinants that may be differentially important for Veterans compared with non-Veterans, or between Veterans enrolled in or utilizing certain VHA services, compared with those Veterans who did not. An evidence map is a scoping review that describes key characteristics of existing, published evidence for a broad area of medicine and health.[7,8] Given our goals focused on Veterans, our evidence map did not seek to identify and review the evidence for all social determinants of health, irrespective of populations. Furthermore, in trying to balance the extensive scope of our review with the goal of providing results that have clear implications for VHA policy and future research, we engaged our VHA partners in a prioritization process after the initial evidence map, and selected those social determinants which would undergo more detailed review and reporting of published results (*ie,* rurality, trauma history, sexual orientation and gender identity).

METHODS

DEVELOPMENT OF CONCEPTUAL AND ANALYTIC FRAMEWORKS

In developing our approach for systematically identifying, describing, and interpreting the evidence base for social determinants of Veterans' health, we worked with our VHA partners to first establish a conceptual framework that depicts the complex relationships between social determinants of health, Veteran status or experiences, and health outcomes (Figure 1). This framework draws upon work from the MacArthur Research Network on Socioeconomic Status and Health[9] and the IOM report on prioritization of social determinants for capture by health records.[1] We sought to be inclusive and broad in conceptualizing relevant social determinants, but also considered whether particular social determinants have available measures, and whether they are considered as high priority by national groups and our VHA partners (Table 1). We note that while certain social determinants are consistently named but variably defined or measured (*eg*, income), other social determinants are both inconsistently described and measured (*eg*, exposures to trauma and adversity), thus limiting our ability to compare across past reports and existing frameworks. Nevertheless, development of this conceptual framework with our VHA partners and identification of a starting set of social determinants were critical for clarifying the objectives of our partners and informing our search strategies.

Table 1. Social Determinants of Health

	Standardized Measure Available	High Priority[a] for Capture by Health Records
Individual Factors:		
Education	ü	ü
Employment	ü	ü
Income	ü	NR
Sexual Orientation		ü
Gender Identity		NR
Social Relationships and Living Conditions:		
Marital Status	ü	NR
Social Support	ü	ü
Family SES		ü
Trauma History	ü	ü
Justice Involved		NR
Housing Status		NR
Rurality	ü	NR

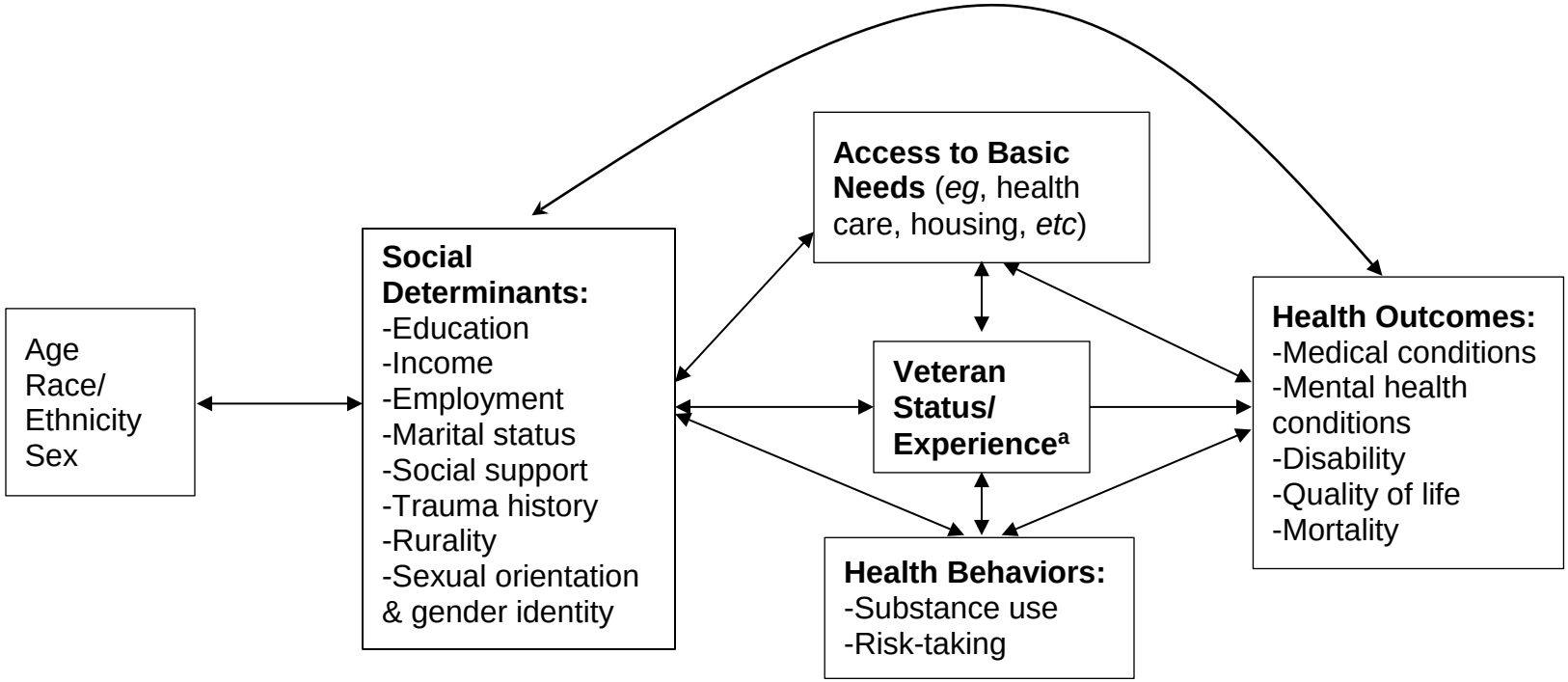
[a] Results adapted from report by Institute of Medicine (2014) Capturing social and behavioral domains and measures in electronic health records: Phase 2; NR = not rated in report

Our conceptual framework highlights some of the complexities arising in the study of social determinants. First, we separated age, race/ethnicity, and sex into their own category, as key demographic characteristics that are distinct from social determinants of health. We acknowledge that these factors have social components (*eg*, definitions of race and ethnicity) and likely interact with social determinants, but they also may be associated with biologic/physiologic variation that impacts health through non-social pathways. The different pathways by which age,

race, and sex impact health are often not distinguished in studies examining outcomes, and attempting to understand the "social" components is beyond the scope of this evidence review. Furthermore, a recent VHA ESP report has focused on health disparities among Veterans, and thus, evaluated the current evidence base for health outcomes associated with these key demographic factors.[10] Thus, our expectation is that robust analyses of impact of social determinants should account for age, race, and sex, in alignment with our main goal of examining the evidence base for social determinants against the backdrop of known impacts of these factors.

Other important considerations include the potential for differential selection of individuals into military service along one or more dimensions of social determinant, nonlinearity in relationships between factors, feedback loops within the complex system of relationships, and interactive dynamic effects due to bidirectionality. Over the life course, pathways are also likely to vary in their influence on health outcomes (*eg*, adversity in childhood vs adulthood). Our model also depicts how social determinants may influence Veteran experiences and engagement with VHA resources, with Veteran status being a mediator of social determinants on health outcomes. For example, a study examining the role of social determinants in health of Veterans compared with non-Veterans addressed the need to distinguish between potential impact of social determinants on differential selection into military service and the other pathways by which social determinants may impact health for Veterans.[11] Alternatively, Veteran status or experience may impact social determinants (*eg*, effect on educational attainment or access to affordable housing), in which case social determinants are mediating the health effects of Veteran status. Additionally, social determinants could *moderate* the relationship between Veteran experiences and health (*ie*, differentially modulating the strength or direction of such associations). Importantly, these distinct roles of social determinants would be examined using different analytic techniques (*eg*, tests for mediation vs examining interaction effects). For example, if trauma exposures have moderating effects, we might observe that the association between Veteran status and health outcome is stronger or weaker among Veterans who have experienced trauma, compared with non-Veterans who have similar exposures. In contrast, if trauma mediates the impact of Veteran status on health, we would find that accounting for trauma exposure would decrease or change the associations between Veteran experiences and health outcomes.

Figure 1. Conceptual Framework for Social Determinants of Veterans' Health



[a] Veteran Status/Experience refers to whether one is a Veteran, including deployed and non-deployed, and various eras of service

In accordance with our conceptual framework, we developed 2 analytic frameworks (Figures 2 and 3) to further clarify our key questions and inform our search strategies. The analytic frameworks helped to identify the populations of interest, highlight social determinants that are likely relevant, define outcomes of interest, and determine the inclusion/exclusion criteria for the evidence review. In comparing our analytic frameworks with the more complex conceptual framework described above, we note 2 key simplifications. First, we are primarily concerned with social determinants as mediators of the effects of Veteran status, or engagement in VHA services or benefits. Thus, in the analytic frameworks, we have not included the potential impact of social determinants on Veteran status (Figure 2) or engagement with the VHA among Veterans (Figure 3). Second, we have indicated unidirectional relationships throughout (*eg*, social determinants affecting health directly, or affecting health services access which in turn affects health) because these are the associations most likely to be examined by published studies, and they are most relevant to addressing the policy concerns of our VHA partners. Evaluating bidirectional relationships between social determinants and health would require robust longitudinal data and more complex analytic techniques. Although such studies would be highly desirable, we did not expect most of the evidence base to fall into this category.

Below, we provide our 4 key questions, and a summary of these questions in PICO format. In Key Questions 3 and 4, we use the terms "engaged" and "non-engaged" to describe groups of Veterans who differ according to enrollment in VHA or other VA benefits and services, or utilization of categories of VHA services (*eg*, mental health or other specialty care).

Key Questions

Key Question 1: How do ***Veterans*** compare to ***non-Veterans*** in prevalence and characteristics of social determinants of health?

Key Question 2: Does variation in social determinants of health account for differences in health services access, health-related behaviors, and health outcomes between Veterans and non-Veterans?

Key Question 3: How do ***engaged*** (*ie*, enrolled in or utilizing categories of VHA services or benefits) Veterans compare to ***non-engaged*** (*ie*, not enrolled in or utilizing VHA services or benefits) Veterans in prevalence and characteristics of social determinants of health?

Key Question 4: Does variation in social determinants of health account for differences in health services access, health-related behaviors, and health outcomes between engaged Veterans and non-engaged Veterans?

PICO

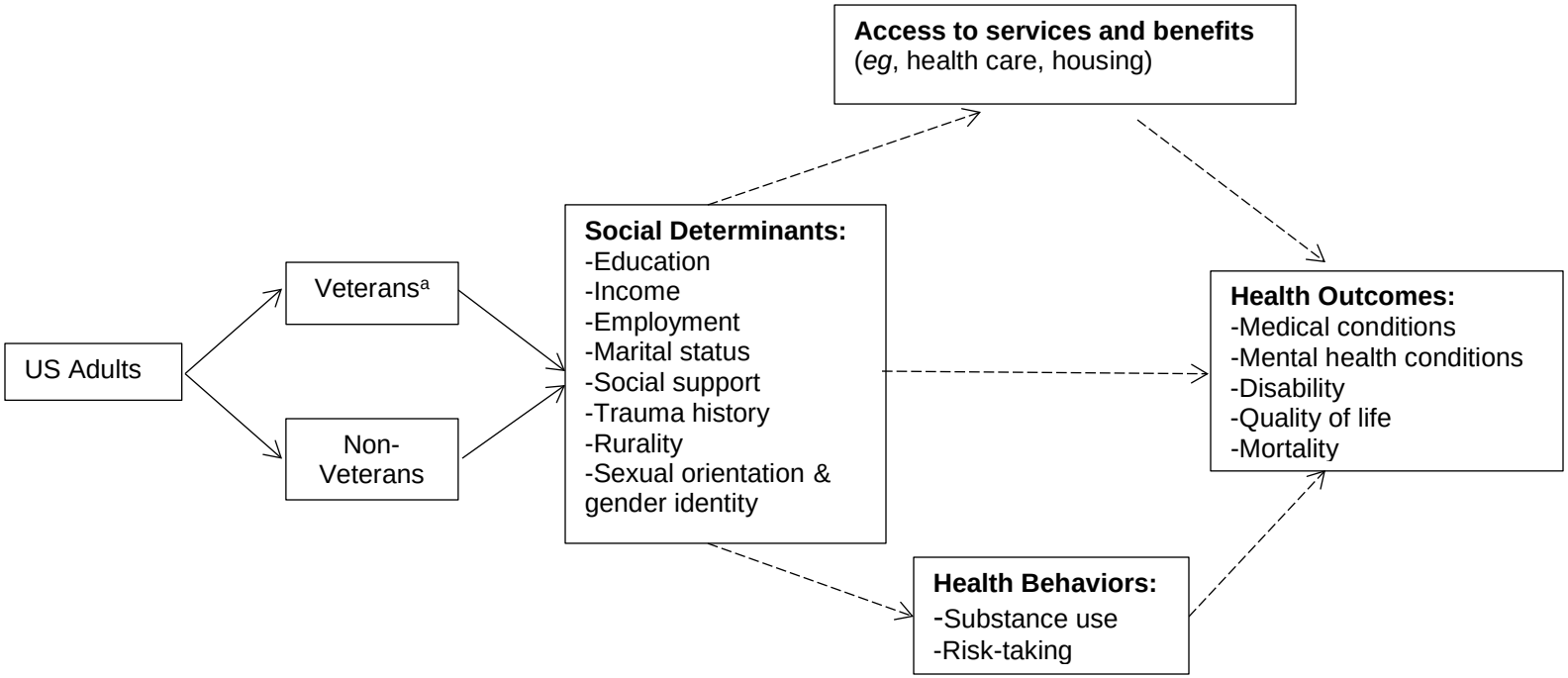
Population: Adult Veterans and non-Veterans

Intervention, Comparator: Not applicable

Primary Outcome: Prevalence and differences in social determinants of health

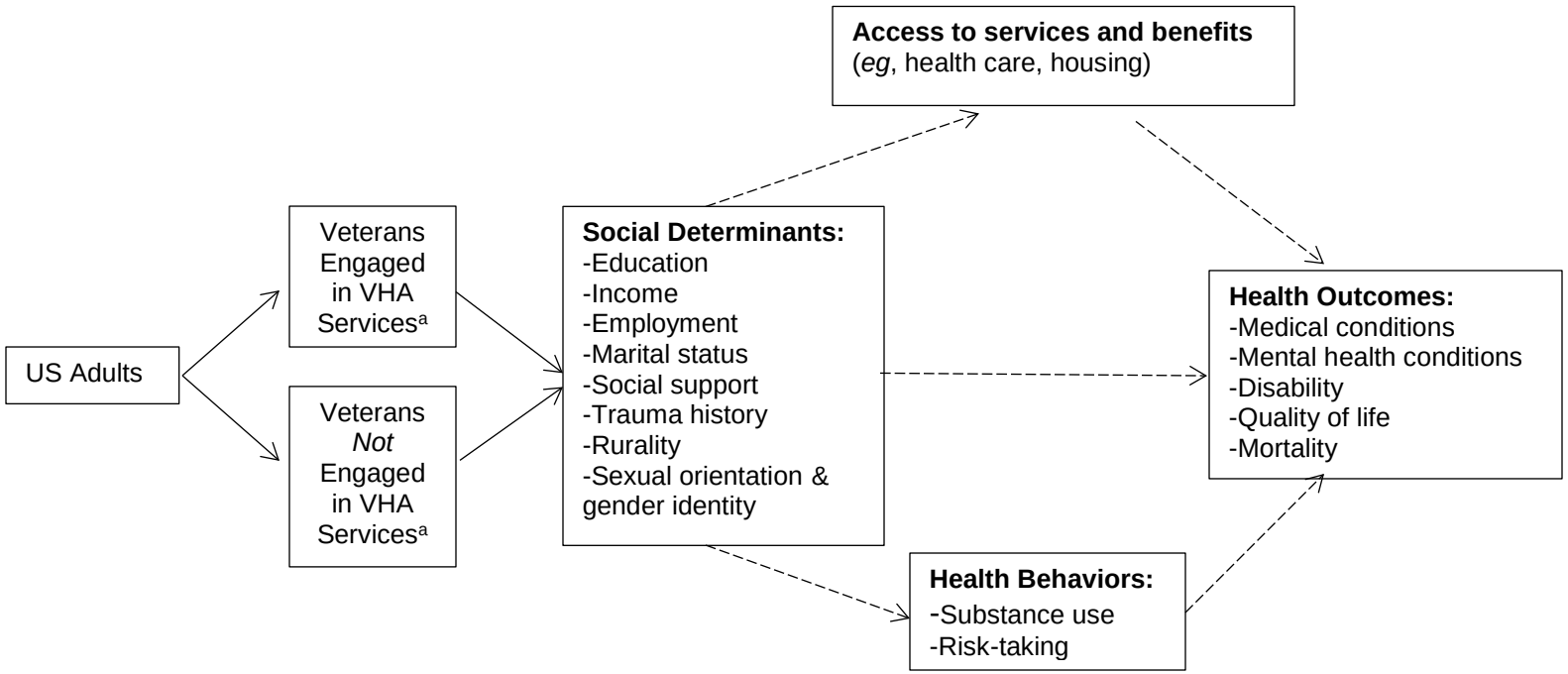
Secondary Outcomes: Differences in health services access, health-related behaviors, and health outcomes, as related to differences in social determinants of health

Figure 2. Analytic Framework for Key Questions 1 and 2



[a] Includes deployed and non-deployed, and various eras of service

Figure 3. Analytic Framework for Key Questions 3 and 4



[a] Engagement in VHA services included use of any VHA benefits or specific categories of services (*eg*, mental health care), as defined by authors of articles.

SEARCH STRATEGY

We undertook a multi-faceted approach to identifying published articles that may be relevant to our key questions. First, we searched MEDLINE (OVID), the Cumulative Index to Nursing and Allied Health Literature (CINAHL), PsycINFO, and Sociological Abstracts, from the date of inception for each database to January 2017, for English language publications. Full database search strategies are presented in Appendix A. To these search results, we added references suggested by experts and peer reviewers. To assess our search results, and also to explore grey literature sources (*eg*, white papers) that may contribute to the evidence base, we undertook an evaluation of publications associated with multiple large national cohorts (*eg*, American Community Survey, Behavioral Risk Factor Surveillance System), and some VA research programs. We first reviewed whether our database search results included articles that used data from these cohorts. Then, we screened citations/abstracts and reports that were associated with these cohorts, as indicated by publication lists, bibliographies, or other available information. We applied this same process to articles and other publications associated with the VA Epidemiology Program and the National Center for Veterans Analysis and Statistics. In general, we did not identify robust sources of evidence in the grey literature that substantially added to our original search focused on peer-reviewed journal articles. Finally, in addition to the database searches and evaluation of publications associated with large national cohorts, we also completed an expedited review of citations found through a MEDLINE search with the terms as noted above (Appendix A), except using "trials" instead of selecting for other study designs. We thought it unlikely that randomized controlled trials or controlled clinical trials would address our key questions regarding the social determinants of health, but for completeness, we carried out this additional search.

STUDY SELECTION

Citations/abstracts identified as potentially eligible by at least one reviewer underwent dual-review of the full texts. At the full-text review stage, 2 reviewers needed to agree on eligibility. Discrepancies were resolved by discussion or a third reviewer. Citation/abstract screening, full-text review, and data abstraction were performed in DistillerSR, (Evidence Partners; https://www.evidencepartners.com/products/distillersr-systematic-review-software/; accessed 5 July 2017).

We applied the following inclusion and exclusion criteria:

Inclusion Criteria

1. Includes data on:

    a. US Veterans and non-Veterans

    and/or

    b. US Veterans engaged and not engaged in VHA services (NOTE: we use engaged and not-engaged for comparisons of groups of Veterans based on enrollment in VHA or other VA benefits and services, or utilization of categories of services [*eg*, mental health or other specialty care])

2. Includes at least one social determinant of interest (*eg*, employment, education, income, family/social support, past trauma exposure, rural residence, gender identity, or sexual orientation). For trauma, we required an independent assessment of trauma exposure; measurement of symptoms and clinical conditions presumed to be related to trauma was not sufficient. We also added new social determinants as they arose in the identified articles.

Exclusion Criteria

1. Fewer than 100 participants

2. Does not report prevalence, degree, levels, or characteristics of social determinants by population of interest (*ie*, Veteran/non-Veteran, engaged/non-engaged)

3. Not study design of interest (*eg*, narrative review, case report, editorial/viewpoint)

Since our goal was to identify evidence that could address the role of social determinants in health, we required that included articles have valid comparison groups (*eg*, rural and non-rural participants, heterosexual and sexual minority respondents). Thus, studies that recruited all participants with a shared social determinant (*eg*, sexual minorities) were not considered as addressing the key questions for that social determinant. We agree that such studies focused on participants sharing a social determinant may be necessary first steps to understanding the potential roles of emerging social determinants of health, but they would not provide sufficient evidence to rigorously examine our key questions.

DATA ABSTRACTION

We undertook a 2-tiered approach to: 1) provide evidence maps of all included articles, and 2) abstract detailed results for articles addressing **3 high-priority social determinants (*ie*, rurality, trauma, and sexual orientation or gender identity**), per our discussions with our VHA partners (subsequently referred to as the 3 high-priority social determinants). For selection of these social determinants, we presented our VHA partners with preliminary evidence maps for KQ1/2 and KQ3/4, which described the number of included articles which addressed specific social determinants and any outcomes of interest.

For all included articles, we abstracted study characteristics (*eg*, cross-sectional or cohort design), social determinants addressed, and whether the article examined the role of social determinants in health services access or utilization, health behaviors (*eg*, substance use), or health outcomes of interest (*eg*, mental health conditions, disability). Next, for articles which investigated one of the 3 high-priority social determinants, we further abstracted the data source (*eg*, NHANES), participant number and demographics, measures of social determinant(s), and the prevalence, degree, or level of social determinant(s) for the groups of interest (*ie*, either Veterans and non-Veterans or engaged and non-engaged Veterans). If articles examined the role of social determinants in health services access, health-related behaviors, and/or health outcomes, we also abstracted methods and results from these analyses. This detailed data abstraction was completed by one reviewer with verification by a second reviewer. Discrepancies were resolved by discussion.

QUALITY ASSESSMENT

We performed dual-reviewer quality assessment for included articles which addressed the 3 high-priority social determinants (*ie*, rurality, trauma, and sexual orientation or gender identity). We considered the following elements related to study quality:

1) Representativeness and coverage (*ie*, source of data [*eg*, nationally representative cohort], recruitment and selection of participants, concerns about missing data)

2) Measurement (*ie*, social determinants assessed in similar manner for groups being compared and using standardized measures; health-related behavior, health services access, and health outcomes assessed in similar manner for groups being compared and using standardized measures)

3) Funding source (*ie*, potential for bias).

Each reviewer independently rated the study quality with regard to assessment of prevalence (Key Questions 1 and 3) and with regard to examining the role of social determinants in health services access, health behaviors, or health outcomes (Key Questions 2 and 4). Discrepancies in quality ratings were resolved by discussion.

DATA SYNTHESIS

We provide 2 separate evidence maps of included articles which addressed social determinants for Veterans and non-Veterans (KQ 1 and 2), and for Veterans engaged and not engaged in VA services and benefits (KQ 3 and 4). We use heat maps to summarize information about the number of articles reporting on various social determinants and the role of social determinants on health services access, health behaviors, or health outcomes.

For articles examining the 3 high-priority social determinants, we undertook qualitative syntheses, as described in the text and detailed tables in Appendix C.

RATING THE BODY OF EVIDENCE

For the 3 high-priority social determinants of rurality, trauma, and sexual orientation or gender identity, we assessed overall strength of evidence as guided by the method described by Owens et al.[12] Strength of evidence was rated as high, moderate, low, or insufficient. We based our rating on precision (degree of certainty in estimates), consistency (direction of differences across included studies), directness (whether evidence links social determinants directly to outcomes of interest), and quality rating of the individual studies (as described above).

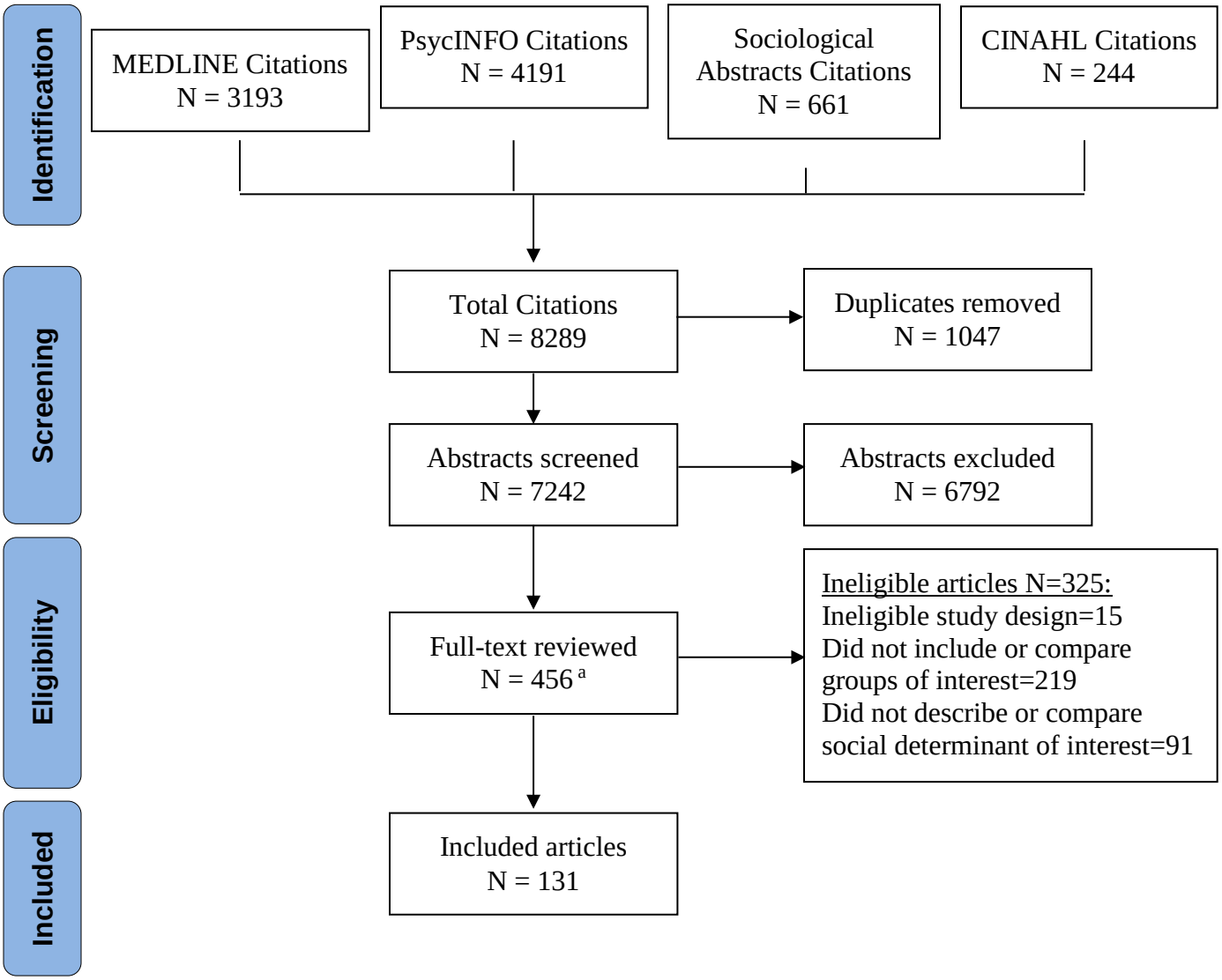
PEER REVIEW

A draft version of this report was reviewed by content experts as well as clinical leadership. Reviewer comments and our responses are presented in Appendix B.

RESULTS

We searched 4 databases and screened over 7000 abstracts to identify 131 articles that addressed at least one of the 4 key questions (Figure 4).[11,13-142] We provide evidence maps, followed by qualitative syntheses of results for the 3 high-priority social determinants—rurality, history of trauma, and sexual orientation or gender identity. We first describe the evidence map and qualitative synthesis for Veterans and non-Veterans (*ie*, Key Questions 1 and 2), followed by results for Veterans engaged and not engaged in various VHA services and benefits (*ie*, Key Questions 3 and 4).

Figure 4. Citation Screening and Selection of Included Articles



[a] Total includes an additional 3 articles found through an expedited review of MEDLINE citations (N=354) found using same search terms except limited to trials, 1 article found through review of publications from the VA Epidemiology Program, and 2 articles recommended by expert reviewers.

KEY QUESTIONS 1 AND 2:

How do Veterans compare to non-Veterans in prevalence and characteristics of social determinants of health?

Does variation in social determinants of health account for differences in health services access, health behaviors, and health outcomes between Veterans and non-Veterans?

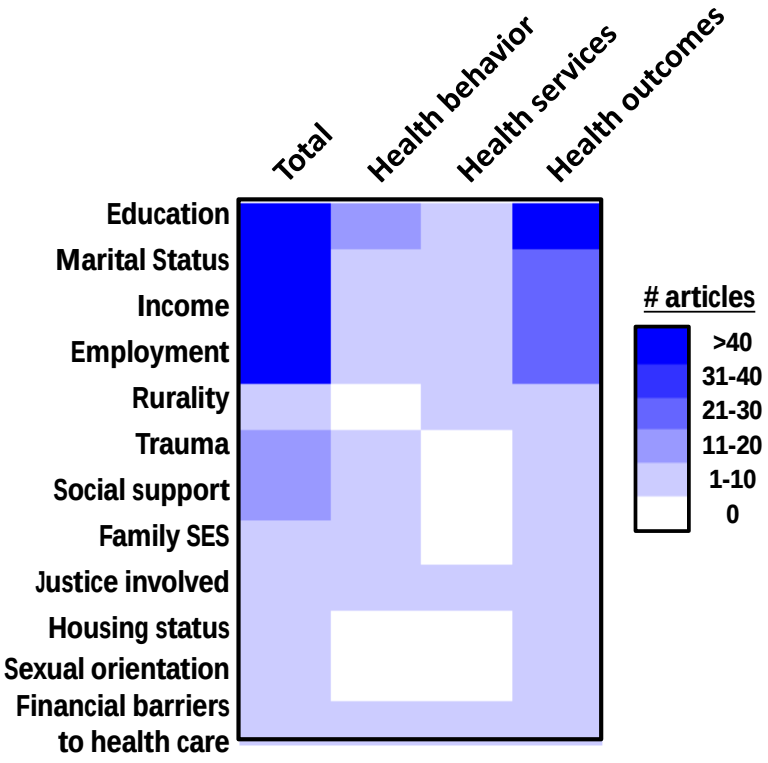
Key Messages

- Most articles examining social determinants of health in Veterans included standard sociodemographics, such as education, marital status, income, and employment.
- There are no substantial differences in proportions of Veterans and non-Veterans who lived in rural settings. Most articles used nationally representative data and were consistent in their results, but rurality definitions varied widely, thus limiting interpretations. (Moderate strength evidence)
- We found insufficient evidence on the effects of rurality on health services utilization, health behaviors, or health outcomes between Veterans and non-Veterans.
- There is higher prevalence of trauma exposure among Veterans, compared with non-Veterans. Half of the articles used nationally representative data, results were somewhat inconsistent, and trauma types and measures varied across articles. (Low strength of evidence)
- Trauma exposure contributes to differences in the smoking prevalence between Veterans and non-Veterans. (Low strength of evidence)
- We found insufficient evidence on whether prevalence differences exist in minority sexual orientation between Veterans and non-Veterans.
- We found insufficient evidence that sexual minority status accounts for mortality differences between Veteran and non-Veteran women.
- No included articles addressed gender identity in comparing Veterans and non-Veterans.

Evidence Map

We identified 99 articles which addressed at least one social determinant of interest for Veterans and non-Veterans. The vast majority of articles used cross-sectional data and included over 1000 participants (Appendix C, Table 1). Education, marital status, income, and employment were addressed by the greatest number of articles, and some of these articles examined the role of these social determinants in health behaviors, health services access or utilization, and/or health outcomes (Figure 5 and Appendix C, Table 1). In contrast, other social determinants were addressed by far fewer articles, and several social determinants were not examined by any articles which considered health behaviors, or health services access or utilization (Figure 5). We found no articles addressing gender identity for Veterans and non-Veterans.

Figure 5. Summary of Included Articles Addressing Social Determinants and Various Outcomes for Veterans and non-Veterans[a]



[a] Shading in a cell represents the number of articles; rows are social determinants of interest and columns are for total number of eligible articles followed by number of eligible article reporting a health-related outcome of interest

Qualitative Synthesis of Results for Rurality, Trauma, and Sexual Orientation and Gender Identity for Veterans and Non-Veterans

We identified 11 articles which examined rurality, 11 which addressed trauma, and 2 on sexual orientation for Veterans and non-Veterans. Most articles on rurality, trauma, and/or sexual orientation used nationally representative datasets, included more than 5000 participants, and were rated low or medium quality (Table 2). One-third of articles included data on only men, and 5 had only women participants. Half of the articles investigated the role of rurality, trauma, and/or sexual orientation in health behaviors, health services access or utilization, or various health outcomes. Detailed results from included articles are provided in Appendix C, Table 2 and described below.

Table 2. Characteristics of Included Articles for Rurality, Trauma, and Sexual Orientation—Veterans and Non-Veterans

	Rurality[a]	Trauma	Sexual Orientation
Total number of articles	11	11	2
Nationally representative dataset	9	6	2
Exclusively men	5	3	—
Exclusively women	—	4	2
Number of participants:			
100-1000	1	3	—
1001-5000	4	3	1
>5000	6	5	1
Quality:			
Low	3	6	—
Medium	7	4	2
High	1	1	—
Examined role of social determinant in:			
Health behaviors	—	4	—
Health services access or utilization	2	—	—
Mental health	2	4	—
General health	1	1	—
Mortality	—	1	1
Other health outcomes	1	2	—

[a] Number of participants unclear in one study (Ajmera 2011[14]); articles may be included in more than one category

Rurality

Articles that examined rurality were all rated medium or low quality. Articles used a variety of measures, including Metropolitan Statistical Areas (MSA),[14,92,99,130,132,142] self-reported rural/urban residence,[26,63,69] and Rural-Urban Continuum (RUC) codes[129] (Appendix C, Table 2). There were generally no differences in the proportion of rural residence between Veterans and non-Veterans, although actual prevalence estimates were highly variable (*eg*, range 18-47% of Veterans had rural or non-metropolitan residences). This was likely due to variation in rurality definition, participant demographics (*eg*, age and sex), and years of datasets used (range 1986-2012). For example, one article used self-reported rural versus urban residence from a national Pew Center survey in 2008 and found 18% of Veterans and 16% of non-Veterans were "rural".[63] Another article using 2000 BRFSS data defined "non-metropolitan" residence by RUC codes 4-9, and reported 25% of Veterans and 22% of non-Veterans were in this category.[129]

Only 3 articles investigated the role of rurality in health outcomes,[99,129,132] all were of medium quality, and none found significant effects for either Veteran status or rurality (Appendix C, Table 2). Of 2 articles examining the association of rurality with health services access or utilization, one reported no substantial difference between metropolitan and non-metropolitan participants in proportion having a "checkup" within prior 2 years.[129] The other article found significant interaction effects between rural residence and a combined Veteran/VHA user categorical variable (*ie*, non-Veteran, Veteran VHA user, and Veteran non-VHA user), when examining associations with total healthcare expenditures, but did not report the magnitude of the interaction effects.[130] Both of these articles were medium quality.

Trauma

Of 11 articles examining trauma exposures between Veterans and non-Veterans, only one was rated as high quality,[82] and 5 were rated as medium quality.[22,27,34,70,93] Articles examining trauma assessed a variety of trauma types, using different measures, with little consistency across studies. Adverse childhood experiences were examined in 6 articles comparing Veterans and non-Veterans,[22,53,70,93,96,111,137] with the Adverse Childhood Experiences scale (ACEs) being the most commonly used measure.[22,70,93] This is possibly because the ACEs module was included in BRFSS, which was the data source used in 3 of these articles. One article reported only whether respondents had been "victimized" in the prior 12 months.[131] Adult experience of sexual trauma or intimate partner violence (IPV) was examined in 4 articles comparing Veterans and non-Veterans.[27,53,96,111] Adult experience of physical trauma was examined in 2 articles comparing Veterans and non-Veterans.[82,96] Combat-related trauma was examined in one article comparing Veterans and non-Veterans (assessed in Veterans only).[96]

Prevalence estimates were inconsistent across articles comparing Veterans and non-Veterans with 6 finding higher prevalence among Veterans,[22,34,70,96,111,131] 3 finding higher prevalence among non-Veterans,[27,53,82] and 2 finding no difference in prevalence between Veterans and non-Veterans.[93,137] Inconsistencies may be due to a broad range of historical periods and cohorts being studied (*ie,* Vietnam era through OIF/OEF, Appendix C, Table 2). Furthermore, comparison groups of Veterans and non-Veterans often differed in composition with respect to age, sex, race/ethnicity, and other key characteristics. There were also very narrow groups targeted in certain articles (*eg*, homeless smokers only).[53]

Only 4 articles examined associations of trauma exposure with health behaviors, and all focused on current smoking and binge or heavy drinking.[27,34,70,93] Trauma exposure was associated with higher prevalence of current smoking, with 2 of these articles examining adult trauma exposure (IPV) and 2 examining childhood trauma exposure (ACEs). Only one of the 4 articles also found a positive association between trauma exposure (ACEs) and binge-drinking.[70] Three of these articles[27,34,70] analyzed trauma exposure as a moderating variable between Veteran status and health behaviors (*ie,* something that potentially changes the strength or direction of association between Veteran status and health behaviors). Of these, 2 did not examine the statistical significance of moderating effects, and the remaining article[70] assessed both smoking (ever smoked) and binge drinking, finding that there were significant interaction effects between Veteran status and ACEs score on having ever smoked (stratified results for women Veterans odds ratio [OR] 1.07 [95% CI 1.03, 1.12] vs women non-Veterans OR 1.14 [95% CI 1.13, 1.15], and comparisons for men, Veterans OR 1.06 [95% CI 1.05, 1.07] vs non-Veterans OR 1.12 [95% CI 1.11, 1.13]). There were no significant interaction effects between Veteran status and trauma exposure (ACEs) in predicting likelihood of binge drinking. Only one article[93] considered whether trauma exposure might be a mediating variable between Veteran status and health risk behaviors (*ie,* something that ***might account for*** the relationship between Veteran status and the health risk behavior). In this article, after adjusting for age, race/ethnicity, education, income, and partnership status, Veterans had a higher OR for current smoking vs non-Veterans (1.84 [95% CI 1.18, 2.88]). After further adjusting for ACEs score, the OR associated with Veteran status was no longer significant (1.57 [95% CI 0.96, 2.58]), suggesting that adverse childhood experiences may explain some of the higher prevalence of current smoking associated with Veteran status.

Five articles examined associations of trauma exposure with a range of health outcomes.[27,34,70,82,93] Several articles found that trauma exposure was positively associated with higher risk for adverse health outcomes. One article found that ACEs scores were associated with poorer health-related quality of life among both males and females, with RRs consistently higher among non-Veterans, compared with Veterans.[70] One article examined trauma exposure as a mediating factor in associations between Veteran status and diabetes, cardiovascular events, asthma, and disability.[93] Veteran status was only significantly associated with disability outcome—adjusted OR 1.83 (95% CI 1.08, 3.10) with covariates including age, race/ethnicity, education, income, and partnership status.[93] After adding ACEs score, the OR for Veteran status was no longer significant (1.57 [95% CI 0.90, 2.75]), suggesting that adverse childhood experiences may account for some part of the higher prevalence of disability among Veterans compared with non-Veterans. Two articles employed BRFSS data to examine associations of IPV with depressive symptoms.[27,34] One reported unadjusted estimates of depressive symptoms comparing Veterans and non-Veterans, with stratification by IPV.[34] There were no differences for those who reported no IPV (7% vs 7% for Veterans vs non-Veterans), but among those reporting IPV, depressive symptoms were less prevalent among Veterans than non-Veterans (13% vs 25%, $p < 0.01$).[34] The second article used both stratified and adjusted analyses, finding broadly similar results, with IPV being associated with higher odds of having depressive symptoms among Veterans (2.63 [95% CI 1.49, 4.65]), and among non-Veterans (4.37 [95% CI 2.79, 6.86]).[27] In the article examining all-cause mortality as the outcome, HRs were significantly higher for certain types of trauma in certain groups but not others; for example, higher HR associated with exposure to physical abuse among heterosexual non-Veterans (1.17 [95% CI 1.02, 1.33]), and higher HR associated with "other trauma" among sexual-minority Veterans (4.31 [95% CI 1.38, 3.47]), but not among other sub-groups.[82] Verbal abuse was not associated with all-cause mortality in any of the 4 sub-groups assessed.[82]

Sexual Orientation

Both articles examining sexual orientation used nationally representative data, had only women participants, and were rated medium quality (Appendix C, Table 2).[80,82] One article used data from the Women's Health Initiative (WHI) and found a higher proportion of women Veterans identified as sexual minorities (*ie,* non-heterosexual) compared to women non-Veterans (4% vs 1%).[82] The other article used NHANES data (1999-2010) and reported no significant difference in prevalence of non-heterosexual orientation (7% among Veterans, 5% for non-Veterans).[80] The 2 study populations differed in age (mean age 63 years in the WHI study and 40 years in the NHANES study) and race/ethnicity (85% non-Hispanic white in WHI study and 70% in the NHANES study).

The article using WHI data found that sexual minority status (HR 1.20 [95%CI 1.07, 1.36]) and Veteran status (HR 1.14 [95%CI 1.06, 1.22]) were independently associated with increased risk for all-cause mortality in adjusted analyses.[82] Authors examined interaction effects between sexual minority status and Veteran status for predicting risk of all-cause mortality, cancer-specific mortality, and cardiovascular disease-related mortality; there were no significant interactions in any of the models for all-cause or cardiovascular mortality, and some inconsistent interaction effects in models evaluating risk for cancer mortality (significant in only half of models).

KEY QUESTIONS 3 AND 4:

How do *engaged* (*ie*, enrolled in or utilizing categories of VHA services or benefits) Veterans compare to *non-engaged* (*ie*, not enrolled in or utilizing VHA services or benefits) Veterans in prevalence and characteristics of social determinants of health?

Does variation in social determinants of health account for differences in health services access, health-related behaviors, and health outcomes between engaged Veterans and non-engaged Veterans?

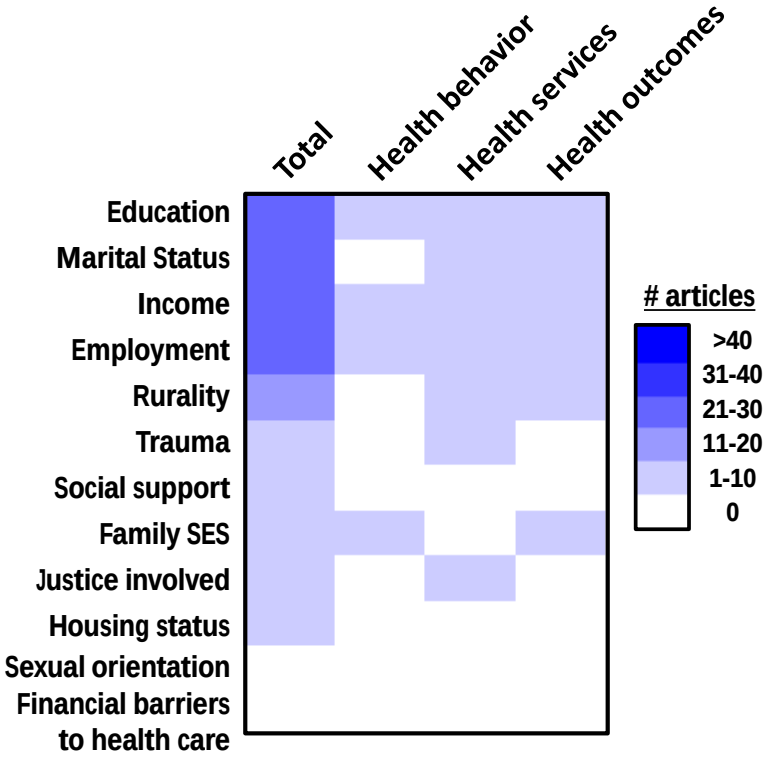
Key Messages:

- Most articles examining social determinants of health in engaged and non-engaged Veterans included standard sociodemographics, such as education, marital status, income, and employment.
- There were no substantial differences in rurality between engaged and non-engaged Veterans, but for certain specific services (*eg*, VHA homeless services), there may be differences in proportion with rural residence. (Moderate strength evidence)
- We found insufficient evidence on the effects of rurality on differences in health services utilization, health behaviors, or health outcomes between engaged and non-engaged Veterans.
- Trauma exposure is higher for Veterans engaged versus not engaged in VHA care. (Low strength of evidence)
- No articles addressed the role of trauma exposure in differences in health services access, health behaviors, or health outcomes between engaged and non-engaged Veterans.
- No included articles investigated sexual orientation or gender identity among engaged and non-engaged Veterans.

Evidence Map

Forty included articles examined social determinants of interest for Veterans engaged and not engaged in VHA services and/or benefits. Most articles used cross-sectional data and education, marital status, income, and employment were the most frequently included determinants (Appendix C, Table 3). Fewer articles examined the role of social determinants in health behaviors, health services access or utilization, and/or health outcomes (Figure 6 and Appendix C, Table 3). Several of the social determinants were examined in less than 10 articles, including trauma exposure and social support.

Figure 6. Summary of Included Articles Addressing Social Determinants and Various Outcomes for Veterans Engaged and Not Engaged in VHA Care[a]



[a]Shading in a cell represents the number of articles; rows are social determinants of interest and columns are for total number of eligible articles followed by number of eligible article reporting a health-related outcome of interest

Qualitative Synthesis of Results for Rurality, Trauma, Sexual Orientation and Gender Identity for Veterans Engaged and Not Engaged in VHA Care

We found 14 articles which examined rurality, 6 which addressed trauma, and none for sexual orientation or gender identity (Table 3). Most articles on rurality and/or trauma used nationally representative datasets. While most articles on rurality included more than 5000 participants and included both men and women, most articles on trauma had 1000 or fewer participants and 4 included only women. Two articles investigated the role of rurality on health services access or utilization, and/or various health outcomes; no rurality articles examined health behaviors. No articles addressed the role of trauma exposure in health services utilization, health behaviors, or health outcomes of interest. Detailed results from included articles on rurality and trauma are provided in Appendix C, Table 4 and described below.

Table 3. Characteristics of Included Articles for Rurality and Trauma—Veterans Engaged and Not Engaged in VHA Services or Benefits

	Rurality[a]*	Trauma
Total number of articles	14	6
Nationally representative dataset	12	4
Exclusively men	2	—
Exclusively women	—	4
Number of participants:		2
100-1000	2	4
1001-5000	2	2
>5000	9	—
Quality:		
Low	4	4
Medium	8	2
High	2	—
Examined role of social determinant in:		
Health behaviors	—	—
Health services access or utilization	2	—
Mental health	—	—
General health	1	—
Mortality	—	—
Other health outcomes	1	—

[a] Number of participants unclear in one study (Ajmera 2011[14]); articles may be included in more than one category

Rurality

Articles on rurality for engaged and non-engaged Veterans were mostly of medium or low quality, with only 2 being high quality. As in articles examining rurality for Veterans and non-Veterans, these articles used a variety of measures of rurality (*eg,* MSA,[14,48,130] self-reported rural/urban residence,[63,100,113] and RUC codes,[74,129] Appendix C, Table 4). Additionally, several articles used Rural-Urban Commuting Area (RUCA) codes[19,40,41] and one assessed straight-line distances between participant homes and the nearest VHA facility.[91] Articles used datasets across 3 decades (1997-2013) and a variety of sources, including large nationally representative surveys, VHA administrative data, and local surveys. In general, articles found small or no difference in the proportion of rural residence between engaged and non-engaged Veterans, with prevalence estimates ranging from 6-26%. For example, one article using 2000 BRFSS data reported 30% of engaged Veterans and 24% of non-Veterans resided in "non-metropolitan" areas (defined by RUC codes).[129] One article found differences in rural residence (engaged Veterans 18% rural vs non-engaged 28%), but focused exclusively on Native Americans who were enrolled in VHA and the Indian Health Service, and also included non-Veterans in the non-engaged group.[74] Two articles which were rated high quality both used VHA data, and one used VHA classification of rural vs urban,[66] and the other employed zipcode-based approximations of RUCA.[19] Hynes et al[66] compared Veterans who utilized VHA services with those who used services paid by Medicare, finding little difference in rural residence (21% vs 19 %). Blackstock et al[19] compared Veterans who used or did not use VHA homeless service, and reported 15% rural residence among those who accessed these services compared with 21% for Veterans who did not.

Only 3 articles investigated the role of rurality in health services access or utilization and/or health outcomes, and all were of medium quality.[14,129,130] No articles examined the role of rurality in health behaviors (Appendix C Table 4). One article reported no substantial difference

between metropolitan and non-metropolitan participants in proportion having a "checkup" within prior 2 years,[129] and the other article found significant interaction effects between rural residence and a combined Veteran/VHA user categorical variable (*ie*, non-Veteran, Veteran VHA user, and Veteran non-VHA user) in associations with total healthcare expenditures but did not report the magnitude of the interaction effect.[130] Both articles examining the role of rurality in health outcomes[14,129] found no significant effects for rurality; one looked at days of poor physical or mental health or otherwise limited by health,[129] and the other determined associations with hospitalization for ambulatory-care sensitive conditions (Appendix C, Table 4).[14]

Trauma

None of the 6 articles examining trauma exposures for engaged and non-engaged Veterans were rated as being high quality; 3 articles[100,108,113] were rated as being medium quality. Across all articles, engagement with VHA was based on self-report of whether individuals were current or recent users of VHA services vs past or never users. As with articles comparing Veterans and non-Veterans, a variety of trauma types and measures were studied, with little consistency across studies. One article examined adverse childhood experiences and adult experience of sexual trauma or IPV,[81] 3 articles addressed combat-related trauma and sexual or non-combat related physical trauma specific to military service,[81,100,108] one article examined history of military sexual assault,[52] and one article examined Vietnam war-zone service.[52] One article investigated military trauma related to sexual minority status.[113]

Estimates of trauma prevalence were primarily unadjusted and somewhat consistent across articles comparing engaged and non-engaged Veterans, with 5 finding higher prevalence among engaged,[45,52,81,108,113] and one finding no difference in prevalence between engaged and non-engaged.[100] One article addressed combat trauma, reporting higher prevalence among engaged in unadjusted estimates, but no significant differences in adjusted estimates.[108] Another article examined prevalence of military trauma related to sexual orientation, finding no difference in unadjusted estimates, but positive associations with VHA use in adjusted analyses.[113]

SUMMARY AND DISCUSSION

SUMMARY OF EVIDENCE FOR KEY QUESTIONS 1 AND 2

Most articles examining social determinants of health in Veterans and non-Veterans addressed standard sociodemographics, such as education, marital status, income, and employment. Fewer articles addressed other social determinants, including those that were high priority for our operational partners.

Included articles that examined rural residence had wide variation in the definition of rurality, limiting interpretations. However, most articles used nationally representative data and were consistent in reporting little or no differences in proportions of Veterans and non-Veterans who lived in rural settings. Thus, we found moderate strength evidence of no substantial differences in rurality between Veterans and non-Veterans. In contrast, we found insufficient evidence on the effects of rurality on differences in health services utilization, health behaviors, or health outcomes between Veterans and non-Veterans. We identified only 5 articles that pertained to these important questions, and these articles varied in data sources, participant demographics, measures of rurality, analytic strategies, and outcomes examined.

Included articles on trauma examined a wide variety of exposures, including type, timing, and measures used. Overall, we found low strength evidence that there is higher prevalence of trauma exposure among Veterans, as compared with non-Veterans. We found low strength evidence that trauma exposure contributes to differences in prevalence of smoking between Veterans and non-Veterans. While several articles examined these associations,[27,34,70] only one reported testing for statistical significance of moderating effects (*ie*, interaction between Veteran status and trauma exposure in predicting smoking).[70] Results from all 3 articles supported an increased effect of trauma in non-Veterans in predicting smoking. Thus, there were consistent associations of current smoking with prior trauma exposure, regardless of whether the type of trauma being assessed was childhood adversity, adult sexual trauma, or physical trauma. In addition, one article also found that childhood adversity mediated associations between Veteran status and smoking and between Veteran status and disability.

Only 2 articles addressed sexual orientation for Veterans and non-Veterans. These included only women, had very different demographics (*eg*, age), and small numbers reporting minority sexual orientation. While one article found a higher proportion of women Veterans identifying as sexual minorities, the other article reported no differences. Thus, we found insufficient evidence on whether there are differences in prevalence of sexual minorities between Veterans and non-Veterans. Only one article assessed the role of sexual minority status on health outcomes, and while it found independent associations between sexual orientation and mortality, the analyses did not examine whether sexual minority status accounted for differences in mortality between Veterans and non-Veterans.

SUMMARY OF EVIDENCE FOR KEY QUESTIONS 3 AND 4

Most articles examining social determinants of health in engaged and non-engaged Veterans included standard sociodemographics, such as education, marital status, income, and employment. Very few articles addressed other social determinants, and we found none that investigated sexual orientation, gender identity, or financial barriers to health care.

Similar to articles that examined rurality among Veterans and non-Veterans, variation in the definition of rurality and participant demographics limit interpretations. However, most articles were consistent in reporting little or no differences in proportions of engaged and non-engaged Veterans who lived in rural settings. We found moderate strength evidence of no substantial differences in rurality between engaged and non-engaged Veterans, but for certain specific services (*eg*, VHA homeless services), there may be differences in proportion with rural residence. We found insufficient evidence on the effects of rurality on differences in health services utilization, health behaviors, or health outcomes between engaged and non-engaged Veterans. We found only 3 articles that were applicable to any of these questions, and there was variation in data sources, participant demographics, measures of rurality, analytic strategies, and outcomes examined.

Articles addressing trauma exposure for engaged and non-engaged Veterans also examined many types of trauma experienced over different time periods. Overall, we found low strength evidence that there is increased trauma exposure for engaged Veterans, as compared with non-engaged Veterans. Most articles found higher levels of trauma reported among engaged Veterans, compared with non-engaged Veterans, but they were of low or moderate quality.

We identified no articles that addressed the role of trauma exposure in differences in health services access, health behaviors, or health outcomes between engaged and non-engaged Veterans. Similarly, we found no articles that examined sexual orientation or gender identity for engaged and non-engaged Veterans.

LIMITATIONS

We provide an evidence map and qualitative syntheses of results from a subset of articles which addressed high-priority social determinants for our VHA partners. Evidence maps are designed to give a broad overview of the evidence base rather than provide in-depth data analyses and outcome summary estimates. Results from evidence maps are best used to describe areas where research has been conducted and where major gaps exist. Articles were excluded if they did not compare the populations of interest (*ie*, Veteran/non-Veteran, engaged/non-engaged), as it was beyond the scope of this work to compare results for these groups when presented in separate studies. Thus, lack of evidence for any given social determinant and outcome of interest speaks only to whether published studies compared the impacts of social determinants for our groups of interest, and our results do not imply that evidence is lacking for effects of social determinants on health overall or within each of these populations. We limited quality assessment to included articles that examined at least one of the 3 high-priority social determinants (rurality, trauma, and sexual orientation or gender identity). Publication bias may have affected our results if articles were less likely to be published if they found no evidence of differences in social determinants or lack of a role for social determinants on health behaviors, health access, or health outcomes. We acknowledge some variation in defining Veteran status, particularly for articles using data from large national cohorts of the general US population. These cohorts used slightly different questions in describing service in the military (*eg*, US armed forces instead of US military) but were very similar in general. Some excluded individuals in active service (*eg*, NHIS), while others obtained more information about current vs past service (*eg*, BRFSS). WHI was the only dataset that had a time criterion (*ie*, 180 days of active service) for qualifying as a Veteran. Finally, although we aimed to be broad and inclusive in addressing social determinants of health,

we needed to limit the scope and therefore focused our search on social determinants with available measures and of high interest to our VHA partners.

APPLICABILITY AND IMPLICATIONS FOR POLICY AND PRACTICE

Our evidence review directly contributes to several essential strategies for improving VHA services and enhancing Veteran health, as outlined in the Blueprint for Excellence.[143] For example, the first essential strategy seeks to meet the needs of the most vulnerable Veterans, including those with low socioeconomic status. Other strategies emphasize the personalization of care and promote the delivery of patient-centered care, which requires understanding the contribution of social determinants, particularly regarding implications for tailoring and targeting of VHA services. Our evidence review has demonstrated that the evidence base for social determinants of Veterans health largely mirrors what is known about the general population. Namely, there is a large body of evidence addressing classic socioeconomic factors, but there is a lack of evidence about more recently developed and conceptualized social determinants, such as trauma exposures, sexual orientation, and gender identity. The policy implication of this result is to support development and implementation of consistent, accurate measures of these social determinants for Veterans. This would enable future work to understand the effects of such social determinants on health behaviors, health services utilization, and health outcomes.

In areas where we did not identify sufficient evidence that examined the differential impact of certain social determinants (*eg*, rurality) on our outcomes of interest, for either Veterans compared with non-Veterans or for engaged and non-engaged Veterans, our evidence review provides indirect support for policies that apply knowledge of the effects of these social determinants in the general US population. For example, both Veterans and non-Veterans, and engaged and non-engaged Veterans appear similar in proportions residing in rural settings, and thus, it would be reasonable to use information about challenges to health and health care in rural US communities, to help direct VHA policies addressing health care access for Veterans in rural settings.

In contrast, we found some evidence that trauma exposures may be different between Veterans and non-Veterans, and between engaged and non-engaged Veterans, suggesting that understanding the impacts of trauma on health care utilization and outcomes could help inform VHA policies for current and future service needs. This also highlights the importance of establishing consistent, accurate, and meaningful measures of trauma exposure in VHA data systems, in order to improve outcomes for Veterans now and in the future.

RESEARCH GAPS/FUTURE RESEARCH

This evidence review represents an extensive and thorough examination of available sources of evidence to address the role of a variety of social determinant. In addition to systematic searches of large databases of published articles, we also examined grey literature (*eg*, white papers) associated with nationally representative cohorts and large VA research studies and programs. Because we found no additional substantial contribution from the grey literature, our review provides a guide to the existing peer-reviewed scientific literature that address a variety of important social determinants. Thus, this work enables future evaluations and syntheses of the evidence supporting the role of social determinants in health, beyond the 3 high-priority determinants that we examined in detail. Another important contribution of this evidence review is to identify major gaps in clinical evidence and guide future research to improve care quality,

delivery, and policy. The first major evidence gap is the lack of articles that addressed certain social determinants, such as gender identity; the evidence gap is even greater with regard to the role of social determinants in health care access, health behaviors, and health outcomes. In the context of our main goals to understand social determinants for Veterans and non-Veterans, and engaged and non-engaged Veterans, the ability to conduct research and generate evidence depends on whether these determinants are being assessed by national studies that also characterize Veteran status, or Veteran utilization of and engagement with VHA services. Thus, some of the areas which lack published articles would greatly benefit from inclusion of consistent measures of social determinants and military experience. To that end, it may be easiest to promote the addition of assessments for certain social determinants (*eg*, sexual orientation) to existing national studies that already collect information about Veterans (*eg*, American Community Surveys). To address lack of evidence for social determinants affecting health of Veterans engaged and not engaged in VHA services, we need data sources that provide information on social determinants and non-VHA health care access and utilization for both engaged and non-engaged Veterans. Included articles that examined social determinants have largely used VHA data, in combination with other administrative or health data collected for a limited group (*eg*, Medicare patients or Indian Health Service).

In addition to the major gaps related to lack of existing data, our evidence review brought to light several challenges to understanding the role of social determinants, even when there are published studies. First, in our detailed review of rurality and trauma, we found that measurement diversity led to inconsistent results and interpretation challenges. Past work has also shown that rurality measure variability leads to substantially different estimates of rural residence among Veterans engaged in VHA care.[144] Moreover, measures for both rurality and trauma actually encompass conceptually related but distinct aspects within these broader constructs. Rural communities are not just defined by distance and/or population density, but also by social connections, cultural norms, and attitudes.[145] As we seek to understand the mechanism by which rural Veterans may experience worse health outcomes, so that we can improve those outcomes, we need direct measures of the aspects of rural communities that matter for health. Similarly, although a variety of adverse circumstances and traumatic events could all plausibly affect Veterans' health, if we fail to make conceptually important distinctions between types of trauma, then it will be harder to clearly define relationships and target pathways for improving health outcomes.

Second, it is important to consider that the relationships between Veteran experiences and social determinants are likely bidirectional and dynamic over the lifespan (Figure 1). One example of these complex relationships is with educational status, where education can affect selection into the military and being a Veteran could in turn impact educational attainment (either in the military or after military service).[146] In the modern era of military service without conscription, social determinants may have even stronger effects on who joins the military and their military experiences. For example, one trauma article examined this potential complexity by carefully accounting for differences between "draft era" Veterans and "all volunteer era" Veterans.[22] In adjusted analyses using BRFSS data, this article found that the number of ACEs was significantly different between Veterans and non-Veterans in the "all volunteer" period ($p<0.001$) but not in the draft era ($p=0.96$). The article also stratified analyses by men and women, finding that the differences in trauma results between these different time periods were mainly in men (who could be drafted before 1973), but not in women (who were never eligible

for conscription). For rurality, it may be that both rural residence in childhood and current rural residence are important for health, but not in the same ways.

Third, a major challenge in this field is to accurately and efficiently identify literature that addresses the questions posed. To refine our scope, we devoted extensive effort to develop conceptual and analytic frameworks to better understand and define the roles of social determinants as they might differentially vary in prevalence or impact among Veterans versus non-Veterans and engaged versus non-engaged Veterans. We used broad search terms to query several databases, and we examined multiple sources of "gray literature." We searched and screened over 8000 citations, and less than 2% met eligibility criteria. Many studies assessed social determinants but did not provide information on the independent and differential effect or prevalence of social determinants in the populations of interest. We encourage others to review our conceptual and analytic frameworks and provide suggestions for future refinement. Having clear conceptualizations of how social determinants may affect health is central for developing knowledge of causal pathways and understanding the independent role of social determinants in health, healthcare delivery, and healthcare policy for Veterans.

While longitudinal and nationally representative cohort studies would be the ideal design for examining the complex interplay of social determinants of health and Veteran experiences, conceptually clear and innovative analyses of cross-sectional data also have the potential to substantially advance our understanding. Such analyses should address potential selection effects of social determinants and other mechanisms that predate military service, as well as social determinants that are affected by Veteran experiences and may mediate the differences in health after those experiences. To support such work, we need multidisciplinary teams that include content and methodologic experts in the diversity of social determinants, as well as investigators with experience in clinical, operational, and policy settings.

Summary of Major Research Gaps and Recommendations:

- Promote inclusion of consistent and accurate assessments of high-priority social determinants (*eg*, trauma exposures, sexual orientation) for existing or ongoing national datasets that also capture Veteran status.

- Develop new data sources and/or improve ability to link with existing non-VHA data sources, in order to address social determinants and outcomes for Veterans engaged and not engaged in VHA services or benefits.

- Apply measures of social determinants more consistently and whenever possible, provide sufficient detail to address how social determinants may be affecting outcomes.

- Develop and utilize clear conceptual frameworks that guide analytic decisions and interpretation of results.

CONCLUSIONS

While extensive literature addresses education, marital status, income, and/or employment, little published work exists on other social determinants of health (*eg*, trauma and sexual orientation). We found no differences in rural residence between Veterans and non-Veterans, and between engaged and non-engaged Veterans. Trauma exposure among Veterans was higher in engaged

versus non-engaged Veterans. We found insufficient evidence to determine if there are differences in sexual orientation or gender identity between Veterans and non-Veterans or between engaged and non-engaged Veterans. Social determinant knowledge gaps could be addressed by clear conceptual frameworks and innovative analytic strategies, even if limited by using cross-sectional data. Direct standardized measurement of key community characteristics of rural settings and focused assessment of specific types of trauma may be more informative for defining pathways that could be targeted for improving the health of Veterans.

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APPENDIX A. SEARCH STRATEGIES

MEDLINE

1	exp Veterans/
2	(veteran$ or VHA or VAMC or VAHCS).mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]
3	1 or 2
4	exp Socioeconomic Factors/ or exp "Social Determinants of Health"/
5	(social adj2 determinant$).mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]
6	((social adj2 factor$) or (behavior$ adj2 factor$)).mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]
7	(transgender or gender identity).mp. or exp Gender Identity/ [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]
8	((sexual adj3 minority) or sexual orientation or sexual preference).mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]
9	(employ$ or unemploy$ or underemploy$).mp.
10	exp Employment/ or job opportunities.mp.
11	(impoverished or low-income).mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]
12	exp Educational Status/
13	(academic or occupation$ or degree or diploma).mp.
14	(family dysfunction or child$ neglect or runaway or foster care).mp.
15	social support.mp. or exp Social Support/
16	exp Foster Home Care/ or foster home.mp.
17	child abuse.mp. or exp Child Abuse/
18	exp Life Change Events/ or adverse childhood event$.mp.
19	Violence.mp. or exp Violence/ or exp Domestic Violence/ or exp Intimate Partner Violence/ or exp Exposure to Violence/ or exp Workplace Violence/
20	((trauma or violence) and (child$ or youth or adol$)).mp.
21	exp Poverty/ or poverty.mp.
22	exp Repression, Psychology/ or exp "Adult Survivors of Child Abuse"/ or exp Child Abuse, Sexual/
23	(intimate partner violence or IPV).mp.
24	exp Homeless Youth/ or exp Homeless Persons/ or homeless$.mp.
25	exp Health Services Accessibility/
26	(access and care).mp.
27	exp Rural Health/ or exp Rural Population/ or exp Rural Health Services/ or rural$.mp.
28	exp Urban Health Services/ or exp "Health Services Needs and Demand"/
29	exp Suburban Health Services/
30	exp Criminals/ or exp Criminal Behavior/ or (justice-involved or (justice adj involved) or (Veteran$ adj2 court) or incarcerat$ or prison or jail or recidivism).mp.
31	(community resource$ or neighborhood or transportation or parks or mobility or livability).mp.

32	exp Residence Characteristics/
33	exp Environment Design/
34	demograph$.mp.
35	4 or 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 or 16 or 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24 or 25 or 26 or 27 or 28 or 29 or 30 or 31 or 32 or 33 or 34
36	3 and 35
37	exp Epidemiologic studies/ or exp case-control studies/ or exp cohort studies/ or case control.tw. or (cohort adj (study or studies)).tw. or cohort analy$.tw. or (observational adj (study or studies)).tw. or longitudinal.tw. or retrospective$.tw. or prospective$.tw. or cross-sectional.tw. or exp cross-sectional studies/
38	36 and 37
39	limit 38 to english language
40	limit 36 to (clinical study or clinical trial, all or clinical trial or comparative study or controlled clinical trial or evaluation studies or government publications or letter or meta analysis or multicenter study or observational study or pragmatic clinical trial or randomized controlled trial or systematic reviews)
41	limit 40 to english language
42	limit 36 to (pragmatic clinical trial or randomized controlled trial)
43	42 not 38

CINAHL

S1	AB ((social N2 determinant*) OR (socioeconomic N2 factor*) OR (social N2 factor*) OR (behavior* N2 factor*))
S2	AB (transgender OR gender identity OR (sexual N3 minority) OR “sexual orientation” OR “sexual preference”)
S3	AB (employ* OR unemploy* OR underemploy* OR (job N2 opportun*) OR poverty OR impoverished OR low-income OR “low income” OR academic OR occupation* OR degree OR diploma OR education*)
S4	AB (“family dysfunction” OR (child* N2 neglect) OR runaway OR “foster care” OR “social support” OR “foster home” OR (child* N2 abuse) OR (life N2 chang* N2 event*) OR (adverse N2 childhood N2 event*) OR violence OR “domestic violence” OR “intimate partner violence” OR IPV or (exposure N2 violence) OR (work* N2 violence) OR ((trauma OR violence) AND (child* or youth or adol*)) OR homeless*)
S5	AB ((“health services” AND (need* OR demand OR access*)) OR (access AND care) OR (access AND service*) OR rural* OR (urban AND health) OR (suburban AND health))
S6	AB (criminal* OR “criminal behavior” OR “justice involved” OR justice-involved OR (Veteran* N2 court) OR incarcerat* OR jail OR recidivism)
S7	AB (“community resource*” OR neighborhood OR transportation OR parks OR mobility OR livability OR residence OR (environment* W5 design) OR demograph*)
S8	S1 OR S2 OR S3 OR S4 OR S5 OR S6 OR S7
S9	AB (Veteran* OR VHA OR VAMC OR VAHCS)
S10	S8 AND S9
S11	Limiters: Research Article: Peer Reviewed; English; Exclude MEDLINE records

PsycINFO

S1	DE “Military Veterans”
S2	AB (Veteran* OR VHA OR VAMC OR VAHCS)
S3	S1 OR S2
S4	DE “Socioeconomic Status”

S5	AB ((social N2 determinant*) OR (socioeconomic N2 factor*) OR (social N2 factor*) OR (behavior* N2 factor*))
S6	AB (transgender OR gender identity OR (sexual N3 minority) OR “sexual orientation” OR “sexual preference”)
S7	AB (employ* OR unemploy* OR underemploy* OR (job N2 opportun*) OR poverty OR impoverished OR low-income OR “low income” OR academic OR occupation* OR degree OR diploma OR education*)
S8	AB (“family dysfunction” OR (child* N2 neglect) OR runaway OR “foster care” OR “social support” OR “foster home” OR (child* N2 abuse) OR (life N2 chang* N2 event*) OR (adverse N2 childhood N2 event*) OR violence OR “domestic violence” OR “intimate partner violence” OR IPV or (exposure N2 violence) OR (work* N2 violence) OR ((trauma OR violence) AND (child* or youth or adol*)) OR homeless*)
S9	AB ((“health services” AND (need* OR demand OR access*)) OR (access AND care) OR (access AND service*) OR rural* OR (urban AND health) OR (suburban AND health))
S10	AB (criminal* OR “criminal behavior” OR “justice involved” OR justice-involved OR (Veteran* N2 court) OR incarcerat* OR jail OR recidivism)
S11	AB (“community resource*” OR neighborhood OR transportation OR parks OR mobility OR livability OR residence OR (environment* W5 design) OR demograph*)
S12	S4 OR S5 OR S6 OR S7 OR S8 OR S9 OR S10 OR S11
S13	S3 AND S12
S14	Limiters: Publication Type: Peer Reviewed Journals Periodical; Document Type: Journal Article; English

Sociological Abstracts

S1	Veteran* OR VHA OR VAMC OR VAHCS
S2	(social NEAR/2 determinant*) OR (socioeconomic NEAR/2 factor*) OR (social NEAR/2 factor*) OR (behavior* NEAR/2 factor*)
S3	transgender OR gender identity OR (sexual NEAR/3 minority) OR “sexual orientation” OR “sexual preference”
S4	employ* OR unemploy* OR underemploy* OR (job NEAR/2 opportun*) OR poverty OR impoverished OR low-income OR “low income” OR academic OR occupation* OR degree OR diploma OR education*
S5	“family dysfunction” OR (child* NEAR/2 neglect) OR runaway OR “foster care” OR “social support” OR “foster home” OR (child* NEAR/2 abuse) OR (life NEAR/2 chang* NEAR/2 event*) OR (adverse NEAR/2 childhood NEAR/2 event*) OR violence OR “domestic violence” OR “intimate partner violence” OR IPV or (exposure NEAR/2 violence) OR (work* NEAR/2 violence) OR ((trauma OR violence) AND (child* or youth or adol*)) OR homeless*
S6	(“health services” AND (need* OR demand OR access*)) OR (access AND care) OR (access AND service*) OR rural* OR (urban AND health) OR (suburban AND health)
S7	criminal* OR “criminal behavior” OR “justice involved” OR justice-involved OR (Veteran* NEAR/2 court) OR incarcerat* OR jail OR recidivism
S8	“community resource*” OR neighborhood OR transportation OR parks OR mobility OR livability OR residence OR (environment* PRE/5 design) OR demograph*
S9	S2 OR S3 OR S4 OR S5 OR S6 OR S7 OR S8
S10	S1 AND S9
S11	S10 AND stype.exact(“Scholarly Journals”)
S12	S11 AND la.exact(“ENG”)
S13	S12 AND at.exact(“Article’)

APPENDIX B. PEER REVIEW COMMENTS/AUTHOR RESPONSES

Question	Reviewer Comment	Author Responses
Are the objectives, scope, and methods for this review clearly described?	Yes	Thank you.
	Yes	
	Yes	
	Yes	
	Yes	
	Yes	
	Yes	
	Yes	
	Yes	
Is there any indication of bias in our synthesis of the evidence?	No	Thank you.
	No	
	No	
	No	
	No	
	No	
	No	
	No	
	No	
Are there any published or unpublished studies that we may have overlooked?	No	Thank you.
	Yes - There are studies missing from the sexual orientation section that can correct/clarify some of the statements. Namely, the finding that there is "insufficient evidence whether prevalence differences exist in sexual minority and gender orientation between Veterans and non-Veterans" [by the way, gender orientation should be "gender identity"] should be clarified. The following studies have found, among various datasets, that Veteran status is overrepresented among sexual minority women than heterosexual women, and Veteran status is underrepresented among sexual minority men than heterosexual men: (a) Blosnich, J. R., Farmer, G. W., Lee, J. G., Silenzio, V. M., & Bowen, D. J. (2014). Health inequalities among sexual minority adults: evidence from ten US states, 2010. American journal of preventive medicine, 46(4), 337-349.	Thank you for the suggested 8 articles. Overall, 2 articles had been identified by our searches but were excluded for not meeting inclusion criteria, 1 report is not a peer-reviewed journal article (and thus not eligible for inclusion), and 5 peer-reviewed articles were not identified by our database searches. We reviewed these additional 5 articles, applying the same inclusion criteria, and found that none were eligible. In addition to providing detailed responses about each article below, we also wish to clarify that the proportion of individuals with military experience or Veteran status among certain groups (*eg*, by sexual orientation) would not give equivalent information as the prevalence of social determinants among Veterans and non-Veterans, or among engaged and non-engaged Veterans. We have

	(b) Blosnich, J. R., & Silenzio, V. M. (2013). Physical health indicators among lesbian, gay, and bisexual US veterans. Annals of epidemiology, 23(7), 448-451. (c) Blosnich, J. R., Gordon, A. J., & Fine, M. J. (2015). Associations of sexual and gender minority status with health indicators, health risk factors, and social stressors in a national sample of young adults with military experience. Annals of epidemiology, 25(9), 661-667. (d) Gates, G. J. (2013). Same sex and different sex couples in the American Community Survey: 2005-2011. (available here: http://escholarship.org/uc/item/8dk71277) Also, in addition to some of the studies above, others have documented differences between sexual minority and heterosexual veterans: (a) Blosnich, J. R., Bossarte, R. M., & Silenzio, V. M. (2012). Suicidal ideation among sexual minority veterans: results from the 2005–2010 Massachusetts Behavioral Risk Factor Surveillance Survey. American journal of public health, 102(S1), S44-S47. [Finding: greater prevalence of poor mental health among sexual minority Veterans, compared to heterosexual Veterans, after adjusting for several demographic confounders.] (b) Blosnich, J. R., Gordon, A. J., & Fine, M. J. (2015). Associations of sexual and gender minority status with health indicators, health risk factors, and social stressors in a national sample of young adults with military experience. Annals of epidemiology, 25(9), 661-667. [Finding: Greater prevalence of suicide attempt, HIV infection, and discrimination among LGBT Veterans compared with non-LGBT Veterans.] (c) Blosnich, J. R., Mays, V. M., & Cochran, S. D. (2014). Suicidality among veterans: implications of sexual minority status. American journal of public health, 104(S4), S535-S537. [Finding: Greater prevalence of lifetime suicide ideation among sexual minority Veterans compared with heterosexual Veterans.] (d) Booth, B. M., Mengeling, M., Torner, J., & Sadler, A. G. (2011). Rape, sex partnership, and substance use consequences in women veterans. Journal of traumatic stress, 24(3), 287-294. [Sexual minority women Veterans had higher rates of all measures of rape and rates of lifetime substance use disorder.	expanded the Introduction and Methods to clarify the rationale behind our selection of the latter comparisons as more likely to provide the most relevant results to address priorities and goals of our VHA partner. We have corrected “gender orientation” to “gender identity” on page 19. (a, b) These articles did not meet our inclusion criteria because they lack comparisons between groups of interest (*ie,* Veterans vs non-Veterans, or engaged vs non-engaged Veterans). (c) This article does not meet inclusion criteria as it does not distinguish between active military service and Veterans. (d) This is not a peer-reviewed journal article. We have added it to our discussion of reports and other grey literature. ---------- (a,c,d) These articles did not meet inclusion criteria because they lack comparisons of social determinant (*ie,* sexual minority status) by groups of interest. (b) This article did not meet inclusion criteria, as noted above.

	I also wonder if any studies from the Veterans Aging Cohort Study were located in the search – it's a rare dataset that has a large sample of Veterans who are men who have sex with men. Lastly, George Brown's study of transgender VA Veterans is absent from this review; they compared transgender VHA Veterans with a 3:1 matched group of non-transgender VHA Veterans. Brown, G. R., & Jones, K. T. (2016). Mental health and medical health disparities in 5135 transgender veterans receiving healthcare in the Veterans Health Administration: a case–control study. LGBT health, 3(2), 122-131.	Our search results included 2 published articles which used data from the Veterans Aging Cohort Study. Both of these were excluded because they lacked comparisons between groups of interest. The article by Brown et al did not meet inclusion criteria because it lacks comparisons between groups of interest.
	No	Thank you.
	No	Thank you.
	Yes - Given the broad topic area, I Think there is likely many studies that were overlooked. I can think of several studies that were not included, e.g., National Health and Resilience in Veterans Study, NESARC.	We appreciate the opportunity to clarify whether we found articles associated with these 2 national studies. Our search did not find articles using NESARC data, but we note that this study did not report Veteran status. Our search identified 9 articles using data from the National Health and Resilience in Veterans Study, but none met inclusion criteria. Additionally, as part of our original search process, we evaluated whether our search of databases (*eg*, PubMed) resulted in articles using data from multiple other large, national cohorts. We also examined available publication lists found on the websites associated with these cohorts, and performed a limited search of PubMed for articles using data from these cohorts. In general, most articles found through these steps did not meet inclusion criteria (*eg*, did not compare Veterans with non-Veterans). In the Methods and Discussion, we have added information about this further review of cohorts..
	Yes - There were two articles that I felt should have been included, although I don't think their inclusion would make a difference in the overall findings. The first is: Bernard DM, Selden TM (2016). Access to Care Among Nonelderly Veterans, Medical Care 54(3):243-252. They looked at Nonelderly Veterans and comparable non-Veterans using MEPS from 2006 to 2011. Some of their findings included that access barriers are similar for nonelderly Veterans and comparable non-Veterans for dental and prescriptions. Also, uninsured Veterans have better access to medical care than comparable non-Veterans. The	Thank you for your recommendations. Bernard et al 2016, has been added to our included articles. Eibner et al, 2016, is not a peer-reviewed journal article, and thus, is not eligible for inclusion.

	second is by C. Eibner et al (2016). Current and Projected Characteristics and Unique Health Care needs of the Patient Population Served by the Department of Veterans. Rand Health Quarterly 5(4). They found, for example, that VA patients tend to be older and less socioeconomically well off than Veterans who do not rely on VA for care. Also, that Veterans have a higher unadjusted prevalence of diagnosed health conditions than non-Veterans. These may have been excluded for a specific reason and I just missed it in the exclusion criteria.	
	Yes - Journal of Homosexuality Volume 60 (2013) has multiple pertinent articles	Thank you for your suggestion. We reviewed articles in this volume of the Journal of Homosexuality but did not identify any additional articles meeting our inclusion criteria (*eg*, including comparisons between groups of interest).
	Yes - Several studies of non-VA healthcare use by VA enrollees	
	No	Thank you.
Additional suggestions or comments can be provided below. If applicable, please indicate the page and line numbers from the draft report.	Perhaps I overlooked this but the review did indicate the goal is to examine the evidence base for SDH against the complex and essential backdrop formed by age, race/ethnicity, and sex. I didn't see much reference in the results in regards to age and race in the review. Not sure if this is due to lack of data but it would have been helpful to get more information on that.	We appreciate the suggestion to clarify the relationship of social determinants to age, race, and sex, and elaborate on our results in the context of these key demographic characteristics. We revised the Methods and Results to address these topics.
	I commend the authors for their work; this wasn't a small task, and I imagine they must have pored through tomes of articles to distill this report. I offer a few comments in the spirit of strengthening this review and maximizing its impact to VA. 1. There is variability in how Veteran status is defined across studies – especially those from non-VA data sources. For instance, the military service questions have slight variation between NHANES and BRFSS, and the military question in the Women's Health Initiative data used in Lehavot et al. 2016 was "Have you served in the US armed forces on active duty for a period of 180 days or more?" The authors should include this as a limitation, or potentially provide a table of the different ways that Veteran status was measured. An additional limitation inherent to self-reported Veteran status is the inability to corroborate military service with official records. 2. The discussion (and executive summary) would benefit from emphasizing that the scarcity of studies about sexual orientation and gender identity are directly caused by the lack of data systems	1. We agree that there was variation in how Veteran status was ascertained. Overall, articles used either self-reported past service in the military, or administrative data (*eg*, VHA records, registry or roster of Veterans). Large national cohorts of the general US population used self-reported information on service in the military. The questions were slightly different in describing service in the military (*eg*, US armed forces instead of US military) but very similar in general. Some national datasets excluded individuals in active service (*eg*, NHIS), while others obtained more information about current vs past service (*eg*, BRFSS). If we were not certain that the majority of participants were Veterans (*ie*, not on active duty), we excluded these articles. WHI was the only dataset that had a time criterion (*ie*, 180 days of active service) for qualifying as Veteran. For articles using administrative data to identify Veterans, these often used VHA data to identify Veterans. In the

	collecting this information. This report should clearly recommend that if research in this disparities areas is to move forward, systems must collect data about sexual orientation and gender identity. 3. Akin to the preceding point, sexual orientation and gender identity are woefully absent from the "research gaps/future research" section on page 28. Paragraph 2 points out nuances and challenges of rurality and trauma, yet sexual orientation and gender identity are not discussed at all. This section should be expanded to include points about sexual orientation and gender identity in data collection, and the fact that there have been numerous documents about cognitive testing of such items in survey research (as was done somewhat needlessly for NHIS) and best practice documents (2 of which were authored by The Williams Institute). 4. In these times of increasing scrutiny of federally-funded efforts, it may be helpful to couch this review overtly to relevant VA strategic goals, missions, and directives. Specifically, VHA Directive 2013-003 "Providing health care for transgender and intersex Veterans," or the recently issued VHA Directive 1340 "Provision of health care for Veterans who identify as lesbian, gay, or bisexual." While I understand this is an unfortunate, ever-shifting target with the revolving door of political appointees, other guiding VA documents, such as the Blueprint for Excellence or guidelines from Community Care (or whatever the "guiding" document du jour is currently) may help anchor the importance of this synthesis. 5. Page 1, paragraph 2, line 28: it would be helpful to define the 3 prioritized social determinants at their first mention; currently, the three are not defined until the bottom of page 2. 6. Page 1: recommend editing KQ3 to include the definitions of engaged and non-engaged right after they are mentioned; not having these terms defined is confusing to the reader. Although the author provide the definitions following the questions, it would be easier to include like this: “How to engaged (i.e., enrolled in or utilizing VA services) Veterans compare to non-engaged (i.e., not enrolled in VA services) Veterans…” 7. Page 7: PICO should be included in the abbreviations table.	Discussion, we have included more information about the variation in self-reported Veteran status. 2 & 3. We appreciate the suggestions to discuss that lack of evidence on certain social determinants, such as sexual orientation, reflect lack of existing datasets that assess these social determinants. We revised the Discussion to highlight the lack of data on some social determinants, and our recommendation to include consistent assessments for those determinants that are high priority. 4. Thank you for highlighting the connection between our evidence review and the larger VHA mission and policy goals. We revised the Implications for Policy and Practice to include discussion of these connections. 5. Thank you, the 3 prioritized social determinants have been defined in page 1, paragraph 2. 6. Thank you, this clarification has been added to KQ3. 7. Thank you, PICO has been added to the abbreviations table on p. 7.

	It might be helpful if the Introduction (p. 1) defined social determinants more concretely, with the variables introduced in the inclusion criteria briefly outlined (p. 2, lines 32-35). How were these particular social determinants arrived at? What about others, such as housing/homelessness? Housing status is mentioned on p. 4, line 53, but was not specifically defined earlier as a social determinant in the inclusion criteria. Similarly, justice involved appears later in the report but is not outlined in the criteria. Representativeness/coverage, measurement, and funding source were used to determine study quality (p. 3). It remains unclear to me how study quality was rated (e.g., use of a particular scale?) or arrived at. For example, if a study used a nationally representative cohort with standardized measures but was unfunded, would it be considered "medium" (as opposed to "strong") quality? I'm somewhat concerned that using presence of funding to rate study quality may be inappropriate in this context, as much research utilizing publicly available, nationally representative datasets may be done by investigators without funding. In the first paragraph of the Introduction (p.1), the authors state that they were particularly interested in current eras of military service. This did not appear to be discussed in the findings or elsewhere in the report. <u>In Figures 2 and 3</u> (p. 12-13), there is no pathway shown between "access to services and benefits" and "health behaviors," although those two constructs may impact one another. In addition, there is only one directional arrow from "health behaviors" toward "health outcomes." However, one can envision the arrow going in the opposite direction here as well. Indeed, the self-medication hypothesis suggests that mental health symptoms can lead to substance use as a method of coping with negative affect and distress. This bidirectional relationship is shown in Figure 1 but not in Figures 2 and 3. <u>Key Questions 1 & 2</u> In the section on rurality, the authors describe one study with significant interaction effects (p. 20, lines 51-56). This study is mentioned again on p. 26, lines 4-6. If one of the aims is to describe results for the high-priority areas, it would be helpful to include another sentence that	We appreciate the opportunity to clarify our conceptual and analytic frameworks, which we used to guide the development of our search strategy. However, we also included very general terms such as "social" and "residence characteristics," in order to be as broad as possible. Thus, we did not have a certain set of social determinants that had to be addressed, as part of the inclusion criteria. In fact, we allowed for the emergence of social determinants (whether new concepts or new terminology) among included articles, as we abstracted data on social determinants being addressed by these articles. We revised the Methods to provide more detail on the selection of social determinants. We abstracted funding sources in our quality assessments mainly to address potential conflicts of interest. This is a more common concern for studies of interventions, where commercial support for research is more frequent. We did not identify any commercially sponsored work, in our quality reviews of the included articles for rurality, trauma, and sexual orientation. We revised the Methods to reflect why funding source was included. The reference to eras of service has been removed. Although this was originally discussed as informing how the Veteran experience has changed, this was not a major focus of the final evidence review. As noted above, we clarified the development of our conceptual and analytic frameworks, and how they informed each step of our evidence review. We have also revised the Methods to highlight the differences between the conceptual framework (with its more complex and realistic relationships) and the analytic frameworks (which have simplifications that permitted in depth discussions of analytic choices). The article by West et al, 2009 examined interactions between a combined Veteran/VHA-user variable and rural vs urban setting. However, they did not report the magnitude of the interaction effects, and the text

	describes these findings, as it is currently difficult to understand what the interaction effects were. In the section on trauma (p. 21, lines 32-49), the authors describe in detail the study that looked at trauma as a mediating variable but not those that examined it as a moderating variable. The authors might consider briefly describing the findings on moderation, or explain earlier why those are not a focus of the review. In the section on sexual orientation (p. 22, lines 39-43), the article using WHI data to examine mortality did not examine mediation, as the authors note. Nonetheless, the study did find a significant interaction effect for cancer-specific mortality which is not discussed. Specifically, sexual minority women were at greater risk than heterosexual women for cancer-specific mortality, with effects stronger among Veterans compared to non-Veterans (sexual minority x Veteran HR = 1.70, 95% CI: 1.01-2.85). Figures 5 and 6 (p. 19 and 24) – the social determinants outlined here do not fully overlap with the social determinants outlined in the inclusion criteria (which did not include housing status, justice involved, or financial barriers to health care defined separately from income). They also do not include gender identity. The authors may consider demonstrating greater consistency between the social determinants shown in these figures, in Figures 1-3, in Table 1, and in the list of social determinants included in the inclusion criteria. <u>Summary</u> Page 27, lines 31-33: "There were consistent associations of current smoking with prior trauma exposure, whether childhood adversity or adult sexual or physical trauma were examined." The second part of the sentence is unclear; do the authors mean regardless of whether trauma was examined? Relatedly, could they clarify the finding regarding trauma exposure, Veteran status, and smoking – is it that greater exposure to trauma contributed to higher prevalence of smoking among Veterans compared to non-Veterans? In general, it would be helpful to include directionality when describing findings. For example, on p. 28, lines 16-18, the authors state" Overall, we found low strength evidence that there are substantial differences in	describing these results was difficult to interpret and summarize. We have revised the Results to indicate that authors did not report the magnitude of the interaction effect, and we provide the paragraph in question for reviewer: "*Men enrolled in VA care cost substantially more overall than other men who used health care: VA users' averages were about $1,200–2,900 higher, depending on age group and residence. Among men younger than 65 years, urban–rural differences in total expenditures were small for non-Veterans and Veterans not in VA care, but of Veterans who used the VA for any care, urban men averaged about $1,100 more in total annual expenditures than rural men. Among men 65 years or older, rural VA users had the highest average total expenditures, about $250 more than for urban VA users. Regressions using log-transformed expenditures confirmed these differences, revealing significant main effects for Veteran–VA user status (p<0.0001 for either younger or older men) and its interaction with urban–rural residence (p<.05 for younger men; p<.01 for older men…*" For suggestion regarding trauma results on p 21, lines 32-49, we provided more detail in the Methods discussing the conceptual and analytic frameworks, as noted above. We also include more detail on the articles that presented only moderating effects of social determinants. We added a summary of results from Lehavot et al, 2016, regarding interaction between sexual orientation and Veteran status in predicting risk for all-cause mortality, cancer specific mortality, and cardiovascular disease related mortality. As noted above, we have revised the Methods to clarify how social determinants were selected to inform methodologic choices (*eg*, development of search strategy) but did not preclude identification of social determinants not specifically identified before citation screening and full-text review. Additionally, we have

	trauma exposure between engaged and non-engaged Veterans." They might highlight that the differences are such that engaged Veterans report higher levels of trauma exposure than non-engaged Veterans. <u>Appendix C, Table 2</u> Brown, 2016 – non-urban residence for Veterans 23%, non-Veterans 22%, listed as p<.05. Please double-check the p value (this appears like it should be non-significant). <u>Minor</u> -Page 2, line 18: "Two reviewers independently reviewer titles…" – should be "reviewed" -Page 3, line 28 needs a period at the end of the sentence ("…assessed overall strength of evidence") -Page 4, lines 19-20: "…whether there are differences in trauma exposure exist between…" –the word exist can be deleted. -Page 18, lines 32-34, "found insufficient evidence whether…" –the word "on" is needed between evidence and whether. In addition, the term "sexual minority" is used instead of "sexual orientation" and "gender orientation" is used instead of "gender identity" -Page 23, line 30 – add a period at the end of the sentence. -Page 27, line 41-42 "…insufficient evidence whether there are differences in prevalence of sexual minority between…" – include the word "on" between evidence and whether. Sexual minority should be sexual minorities. -Page 28, line 50 – for consistency, use "non-Veteran" instead of nonVeteran -Page 59, line 42 – under "Prevalence, Degree or Level" column, underline "among women" to be parallel to the underline of "among men" in line 48 -Page 61, line 23 – "sexual Orientation" – orientation does not need to be capitalized -Page 72, Prevalence, Degree or Level column – underline "assault," "combat trauma," and "military sexual" for consistency	revised Results to indicate that there was potential for emergent social determinants. The sentence on page 27, lines 31-33, has been clarified to address the reviewer's question. We have reviewed the data for this article in Table 2, Appendix C. The results are statistically significant due to the large sample size. Thank you, these edits have been addressed.
	Overall the review was concise and well-written. I have several areas for clarification: 1. Definition of social determinants, clarification of the phrase "socially constructed". Would also just state that social determinants are responsible for a large portion of health outcomes, not just variation in	1. We clarified our conceptualization of social determinants and revised the Introduction and Methods to address these concerns, per our response to other reviewers. In these revisions, we expand our consideration of age, sex, and race, and why they were

	health outcomes. Classify what is meant by “essential backdrop”? 2. Was neighborhood environment (independent of rurality) included in selection criteria? E.g. census tract information. Would consider this an important health determinant. Could be added to the social determinants model. 3. Delete the phrase: “we believe that” page 6, line 49-50	not the focus of our evidence review. We also note that we considered inclusion of these key demographics as essential for interpretation of results on the role of social determinants in health, and those that report differences in prevalence or levels of social determinants. 2. Our search strategy was designed to search broadly, by including terms such as “social” and “residence characteristics.” We also searched specifically for other terms related to the general environment, including “community resources,” neighborhood,” and “parks.” 3. Thank you, this edit has been made.
	The authors have conducted an admirable fairly comprehensive review, but have chosen to focus on a very broad topic area, perhaps overly broad since social determinants of health encompasses so many psychosocial constructs. One could argue there are other constructs that were not included, such as neighborhood conditions- noise and crime levels, etc. Also it seemed “justice system involvement” was mostly about criminal justice but civil legal problems are also increasingly being considered as important social determinants of health. It's not clear why the authors chose to describe in detail certain constructs, e.g., sexual orientation, trauma, and rurality. Simply examining the prevalence of these characteristics is a bit odd because then this becomes an exercise in comparing vets and non-vets on various identity characteristics instead of the real focus which is on identifying important social determinants of health. In that way, the major aim of the study should be pinpointing the social variables that are most important or influential on health, but instead it seems there is a somewhat distracting focus on prevalence rather than influence/effect. I was surprised at some of the “key messages” from the review for Q1 and Q2. For example, “insufficient evidence to determine whether there are differences in trauma exposure between Veterans and non-Veterans.” Large epidemiological surveys have been conducted that certainly would be available to answer this fairly easily. The conclusion that there is “insufficient evidence on the effects of rurality on differences in health services utilization” is odd since there is a	Thank you. We agree that this evidence review had a very broad scope, in order to address the goals of our VHA partners. We agree that there are valid arguments for including other social determinants, depending on the overall objectives of the review, and the emergence of new social determinants in the future. Our search included other terms related to the general environment, including “community resources,” neighborhood,” and “parks.” We appreciate the opportunity to clarify the prioritization process for selecting which social determinants would undergo a more detailed data abstraction and review. We revised the Methods to address this concern. Our main objective was to describe the evidence base for social determinants that may be particularly relevant for Veterans’ health, as compared with non-Veterans, or for specific groups of Veterans. As such, we anticipated that a large number of identified articles would be descriptive and not necessarily examine the impact of social determinants on outcomes of interest. Because we wanted to capture this larger descriptive evidence base (*ie*, differences in prevalence or levels of social determinant), we did not require results on outcomes of interest for inclusion of articles. As evidence maps are intended to provide a systematic description of the evidence, this helps us understand the state of the field. For example, if trauma exposures are not being

	preponderance of evidence in the general literature on this effect- people in rural areas have less access to all types of services from grocery stores to hospitals. Finally, there were some strange findings that they authors focused on, e.g., “trauma exposure and prevalence of smoking.” This is a somewhat esoteric focus, the relation between trauma exposure and alcohol/drug abuse is much larger and more important. I thought some parts were not particularly well-written and did not synthesize studies well, felt a little bit thrown-together which may reflect the diffused area the review is focused on. There were several typos without, I'll just point out two: Typo on page 2, line 18 “independently reviewer titles” Typo on page 4, line 20 “differences in trauma exposure exist” Also many of the text in the Tables use abbreviations with no footnotes or anything to spell out what the abbreviations mean.	accurately and consistently measured across settings, then we are less able to understand the impact of trauma on health. As noted above in response to other reviewers, we evaluated whether our search results included articles using data from multiple large, national cohorts. We also examined publication lists and bibliographies associated with multiple large cohorts. In the Methods and Discussion, we added information about this additional evaluation and search. Regarding rurality results, we have revised this section to highlight that our main goal was to determine if the evidence indicated that rurality had a differential impact on health care utilization (among other outcomes), when comparing Veterans to non-Veterans. We were not addressing whether rurality impacts utilization in general. Regarding reviewer’s comments about trauma results, we have reframed our key messages. Additionally, we re-examined the reported results on trauma exposure, Veteran status, and the 2 types or health behaviors, smoking and alcohol use. In 4 articles examining trauma exposure on health behaviors, comparing Veterans and non-Veterans, smoking prevalence was significantly higher among those reporting trauma than among those not reporting trauma. However, there was weak evidence as to whether these associations were differential between Veterans and non-Veterans. Binge drinking was also significantly higher among those reporting trauma than among those not reporting trauma, but these associations were weaker than the associations between smoking and trauma. For binge drinking, evidence also did not indicate differential impact of trauma, when comparing Veterans and non-Veterans. Thank you, these edits have been made.
	Page 1: Executive Summary: After the first sentence, it would help to set the stage about how you are defining social determinants of health; provide some examples. At the end of the paragraph, it is stated "evolving socio-cultural context"... please elaborate or state what this is. Also on page 1, it would be better to put what the terms "engaged" and	We appreciate reviewer suggestions to further clarify our work and elaborate on the implications of our results. Specific edits to the text and figures were made as recommended (*eg*, change of the sentence on Page 2, separation of disability and quality of life outcomes in

	"non-engaged" Veterans mean before the Key questions. Page 2: under Study Selection, the first sentence would read better as "Two investigators independently reviewed... " Under Inclusion, here you provide some examples of what you are interested in with regard to social determinant... this should be moved to the introduction section. Page 10: In Figure 1 (and in other subsequent figures), I don't understand why you have listed Disability, quality of life as one outcome. It seems they should be two separate outcomes of interest. Page 11: Before the Key Question section, it would be helpful to know the process involved that you and your stakeholder went through to arrive at these 4 specific key questions. They are good ones, but it would be interesting to have a bit more background surrounding them. Figures on Pages 12 & 13: See comment for page 10. The Results section on pages 17-26 are interesting and the methods used to produce these results seem solid. Page 28: Section on Applicability and Implications for Policy and Practice is under-developed. Page 28-29 Research Gaps/Future Research - would be helpful to have what I would call a "laundry list" of potential studies that should be undertaken in the future. This would be beneficial in setting a research agenda to address the identified gaps.	Figures 1-3). In the Introduction and Methods, we expanded our presentation of social determinants, development of our conceptual framework, the prioritization process, and the populations of interest, as noted above in responses to other reviewers. Thank you. Per our response to other reviewers, we expanded the implications for policy. We appreciate the suggestion to itemize and summarize our recommendations for addressing research gaps, and revised this section.
	I think you should be much clearer about the limitations of this review and your conclusions, given the constraints of your methods. Regarding rurality, for example, your summary states: “Thus, we found moderate strength evidence of no substantial differences in rurality between Veterans and non-Veterans. In contrast, we found insufficient evidence on the effects of rurality on differences in health services utilization, health behaviors, or health outcomes between Veterans and non-Veterans. . . . . [or] between engaged and non-engaged Veterans.”	Thank you for the noted limitation of our evidence review. We revised the Limitations to highlight this aspect of our review.

	A reader might correctly conclude that Veterans and non-Veterans, or engaged vs non-engaged Veterans, are similarly distributed geographically, but then miss the point that rurality does not affect Veterans and non-Veterans differently and incorrectly conclude that there is very little evidence that rurality is associated with utilization, behaviors, or outcomes, when in fact there is a lot of research suggesting so. The reason you found little evidence is that you limited your review to studies that compared Veterans vs non-Veterans, or engaged vs non-engaged Veterans, which yielded very few studies to consider. So you should be very explicit that while the few studies you reviewed did not provide much evidence of rurality effects, there are several other studies that do. Readers should not be led to think that there is no evidence that rural residence affects utilization etc.	
	Just as a point of information, there is a Partnered evaluation Center funded by QUERI and VA Office of Rural Health that examines access to care among rural Veterans and examines the impact of SDOH on various domains of access. this has focused largely on Veterans engaged in VA care because it is challenging to get meaningful data for non-engaged Veterans. I think another conclusion is the need for good data sources on non-engaged Veterans and the challenges this could be given the challenges of linking VA data with other types of data.	We appreciate the suggestion to include the need for better data on Veterans not engaged in VHA services or benefits, and added this to our research gaps section.

APPENDIX C. EVIDENCE TABLES

Appendix C, Table 1. Summary of Characteristics for Included Articles on Veterans and Non-Veterans

Social Determinant	Total Articles	N > 1000	Study Design		Role of Social Determinant in:		
			Cohort	Cross-Sectional	Health Behaviors	Health Services Access or Utilization	Health Outcomes
Education	81	66	28	53	11	10	45
Marital Status	56	46	20	36	7	6	29
Income	51	43	18	33	5	7	21
Employment	46	37	20	26	5	3	22
Rurality	10	9	4	6	1	2	6
Trauma History	11	9	1	10	4	0	7
Social Support	13	9	6	7	2	0	7
Family Socioeconomic Status	10	9	4	6	2	0	6
Justice System Involved	8	6	0	8	1	2	3
Housing Status	6	5	0	6	0	0	2
Sexual Orientation & Gender Identity	2	2	1	1	0	0	1
Financial Barriers to Healthcare	2	1	1	1	1	2	2

Appendix C, Table 2. Detailed Results and Characteristics of Included Articles Addressing Rurality, Trauma, and/or Sexual Orientation for Veterans and Non-Veterans

Author, Year	Data Source (Year)	*N* Participants (% Women, % Non-White, Mean Age)		Social Determinant		Role of Social Determinant in:		
		Veterans	Non-Veterans	Main Measure(s)	Prevalence, Degree, or Level	Health Behaviors	Health Services Access/ Utilization	Health Outcomes
Rurality								
Brown, 2016[26]	NLSY 79 (1979-1994) NLSY 97 (1997-2010)	1,914 (11%, 28%, 25 y) 520 (23%, 30%, 21 y)	12.686 (52%, 20%, 25 y) 8,984 (50%,27%, 22 y)	Self-reported urban residence vs not	Non-urban residence: NLSY 79-Veterans 72%, non-Veterans 38% (P<.01); NLSY 97- Veterans 23%, non-Veterans 22% (P<.05)	—	—	—
O'Donnell, 2000[99]	MEPS (1996)	662 (0%, 7%, 72 y)	406 (0%, 16%, 75 y)	Rural=non-MSA	Rural: Veterans 33%, non-Veterans 25% (P=.51)	—	—	Neither Veteran status (P=.9) nor rural residence (P=.9) were significantly associated with odds of self-reported poor/fair mental health

Author, Year	Data Source (Year)	*N* Participants (% Women, % Non-White, Mean Age)		Social Determinant		Role of Social Determinant in:		
		Veterans	Non-Veterans	Main Measure(s)	Prevalence, Degree, or Level	Health Behaviors	Health Services Access/ Utilization	Health Outcomes
West, 2006[129]	BRFSS (2000)	14,389 (0%, 13%, NR)	32,796 (0%, 21%, NR)	Metropolitan=RUC codes 1-3; non-metropolitan=RUC codes 4-9	Non-metropolitan: Veterans 25%, non-Veterans 22%	—	"*Regardless of age or VA patient, other Veteran, or non-Veteran status, metropolitan residents (80.7% overall) were slightly more likely than nonmetropolitan ones (78.6%) to have had a checkup within the past 2 years (P<.01).*"	*"*[M]*etropolitan-nonmetropolitan residence factor did not yield significant effects…"* [on days of poor physical or mental health, or health limiting activities]
Kaplan, 2007[69]	NHIS (1986-1994)	104,026 (5%, 16%, NR)	216,864 (62%, 26%, NR)	Self-reported rural vs urban residence	Rural: Veterans 25%, non-Veterans 23%	—	—	—
White, 2011[132]	NSDUH (2008)	1,985 (0%, 17%, NR)	15,654 (0%, 35%, NR)	MSA: non-metropolitan, small and large metropolitan	Non-metropolitan: Veterans 18%, non-Veterans 16%	—	—	*"*[M]*ilitary status was not significantly associated with suicidal ideation…Additional adjustment for…factors* [including rurality]*…did not materially affect our null finding…"*

Author, Year	Data Source (Year)	*N* Participants (% Women, % Non-White, Mean Age)		Social Determinant		Role of Social Determinant in:		
		Veterans	Non-Veterans	Main Measure(s)	Prevalence, Degree, or Level	Health Behaviors	Health Services Access/ Utilization	Health Outcomes
Houston, 2013[63]	Pew Research Center's Internet & American Life Project (2010)	353 (11%, 30%, NR)	2,638 (66%, 46%, NR)	Self-reported rural vs urban status	Rural: Veterans 18%, non-Veterans 16%	—	—	—
West, 2009[130]	MEPS (1996-2004)	12,688 (0%, NR, NR)	35,079 (0%, NR, NR)	Rural=non- MSA	Rural: Veterans 24%, non-Veterans 21%	—	*"*[S]*ignificant main effects* [on total expenditures] *for Veteran-VA user status (p<.001 for either younger or older men) and its interaction with urban-rural residence (P<.05 for younger men; P<.01 for older men…)"*	—
Laudet, 2014[77]	Life in Recovery Survey (2012)	481 (23%, 25%, NR)	2,695 (63%, 17%, NR)	Not described	Rural: Veterans 31%, non-Veterans 26%	—	—	—
McCaskill, 2015[92]	University of Alabama Study of Aging (1999-2009)	301 (0%, 37%,74 y)	200 (0%, 71%, 76 y)	Rural=non-MSA	Rural: Veterans 47%, non-Veterans 58%	—	—	—

Author, Year	Data Source (Year)	*N* Participants (% Women, % Non-White, Mean Age)		Social Determinant		Role of Social Determinant in:		
		Veterans	Non-Veterans	Main Measure(s)	Prevalence, Degree, or Level	Health Behaviors	Health Services Access/ Utilization	Health Outcomes
Ajmera, 2011[14]	MCBS (2001-2005)	NR (unclear # participants)	NR (unclear # participants)	Non-metro= non-MSA	Unable to abstract due to unclear # participants	—	—	Neither Veteran status nor non-metro residence were significantly associated with odds of having any hospitalization due to ambulatory care sensitive conditions
Bernard, 2016[142]	MEPS (2006-2011)	6268 (10%, NR, 50 y)	105,681 (53%, NR, 40 y)	MSA vs non-MSA	Non-MSA: Veterans 18%, non-Veterans 15% (comparisons made for each region, Midwest, *etc*, all non-significant)	—	—	—
Trauma								
White, 2012[131]	Survey of arrestees Maricopa County, AZ (2009)	132 (8%, 39%, 42 y)	1,970 (25%, 55%, 32 y)	Self-reported "victimized" in past 12 months	Victimized: Veterans 42%, non-Veterans 38%	Self-reported & urine results of illicit drug use in past 12 months No significant associations for Veteran status or being victimized for any drug outcome	—	—

Author, Year	Data Source (Year)	*N* Participants (% Women, % Non-White, Mean Age)		Social Determinant		Role of Social Determinant in:		
		Veterans	Non-Veterans	Main Measure(s)	Prevalence, Degree, or Level	Health Behaviors	Health Services Access/ Utilization	Health Outcomes
Schultz, 2006[111]	Survey of Veterans in Minneapolis VHA Women's Clinic, and non-Veteran women in Michigan (2005)	142 (100%, 7.8%, 45 y)	81 (100%, 13%, 35 y)	Self-reported sexual trauma in childhood or adulthood	Childhood sexual abuse: Veterans 43%, non-Veterans 49% Adult sexual victimization: Veterans 58%, non-Veterans 67% Adult sexual assault: Veterans 22%, non-Veterans 49% (P<0.001)	—	—	—
Naifeh, 2008[96]	Medical records of Veterans getting PTSD treatment at 1 Mid-western VHA facility (2000-2003), and non-Veteran crime victims in mental health treatment	191 (8%, 16%, 52 y)	48 (94%, 36 y)	Various types of trauma experiences documented in medical records	Sexual assault: Veterans 10%, non-Veterans 52% Physical assault: Veterans 7%, non-Veterans 31%	—	—	—

Author, Year	Data Source (Year)	*N* Participants (% Women, % Non-White, Mean Age)		Social Determinant		Role of Social Determinant in:		
		Veterans	Non-Veterans	Main Measure(s)	Prevalence, Degree, or Level	Health Behaviors	Health Services Access/ Utilization	Health Outcomes
Dichter, 2011[34]	BRFSS (2006-2008), limited to states with IPV module	503 (100%, 36%, NR)	20,659 (100%, 27%, NR)	Self-reported lifetime IPV	IPV: Veterans 34%, non-Veterans 24% (P<.01)	Self-reported smoking, binge or heavy drinking, and lack of exercise Multivariable analyses modeled associations of IPV with behavior outcomes, controlling for Veteran status: OR 2.8 (95% CI 2.4, 3.2) for smoking, OR 1.8 (95% CI 1.5, 2.1) for drinking, OR 1.1 (95% CI 0.9, 1.2) for lack of exercise	—	Depression defined by ≥10 on PHQ-8 Multivariable model of association between IPV and depression, controlling for Veteran status, OR 3.8 (95% CI 3.2, 4.5)

Author, Year	Data Source (Year)	*N* Participants (% Women, % Non-White, Mean Age)		Social Determinant		Role of Social Determinant in:		
		Veterans	Non-Veterans	Main Measure(s)	Prevalence, Degree, or Level	Health Behaviors	Health Services Access/ Utilization	Health Outcomes
Cerulli, 2014[27]	BRFSS BRFSS (2006-2008), limited to states with IPV module	4,738 (0%, 20%, NR)	8,998 (0%, 29%, NR)	Self-reported lifetime IPV	IPV: Veterans 10%, non-Veterans 13% (P<.01)	Self-reported smoking, binge or heavy drinking, and lack of exercise Multivariable analyses modeled associations of IPV with behavior outcomes, stratified by Veteran status—among Veterans, OR 1.9 (95% CI 1.3, 2.8) for smoking, OR 1.4 (95% CI 0.9, 2.2) for drinking, OR 1.3 (95% CI 0.8, 1.9) for lack of exercise; among non-Veterans, OR 2.0 (95% CI 1.6, 2.6) for smoking, OR 1.7 (95% CI 1.3, 2.2) for drinking, OR 0.7 (95% CI 0.5, 0.9) for lack of exercise	—	Depression defined by ≥10 on PHQ-8 Multivariable model of association between IPV and depression, stratified by Veteran status—among Veterans OR 2.6 (95% CI 1.5, 4.6); among non-Veterans OR 4.4 (95% CI 2.8, 6.9)

Author, Year	Data Source (Year)	*N* Participants (% Women, % Non-White, Mean Age)		Social Determinant		Role of Social Determinant in:		
		Veterans	Non-Veterans	Main Measure(s)	Prevalence, Degree, or Level	Health Behaviors	Health Services Access/ Utilization	Health Outcomes
Blosnich, 2014[22]	BRFSS (2010-2010), states with ACEs module	9232 (8%, 13-18%, NR)	51146 (70%, 20-21%, NR)	ACEs	Comparisons stratified by sex and "all-volunteer" vs "draft" eras—among men, higher prevalence of all categories in Veterans compared with non-Veterans during "all-volunteer" but not in "draft" era; among women, higher prevalence of some categories in Veterans compared with non-Veterans, largely the same for both eras of service	—	—	—
Hammett, 2015[53]	Smokers from Homelessness in Minnesota Survey (2009)	351 (10%, 47%, 47 y)	2,831 (50%, 61%, 36 y)	Self-reported childhood physical or sexual abuse, adult relationship abuse in past 12 months	Childhood abuse: Veterans 39%, non-Veterans 44% (P=.06) Adult relationship abuse: Veterans 16%, non-Veterans 25% (P<.001)	—	—	—

Author, Year	Data Source (Year)	*N* Participants (% Women, % Non-White, Mean Age)		Social Determinant		Role of Social Determinant in:		
		Veterans	Non-Veterans	Main Measure(s)	Prevalence, Degree, or Level	Health Behaviors	Health Services Access/ Utilization	Health Outcomes
McCauley, 2015[93]	BRFSS (2010-2011), states with ACEs module	631 (100%, 15%, 51 y)	35.854 (100%, 16%, 49 y)	ACEs, items grouped by types of adversity: household dysfunction, and childhood abuse (*ie,* physical, emotional, and sexual abuse)	Household dysfunction: Veterans 20%, non-Veterans 21% (p=0.71) Childhood abuse: Veterans 11%, non-Veterans 9% (p=0.22) Mean number of ACEs: Veterans 2.3, non-Veterans 1.7 (p<0.01)	Smoking and heavy alcohol use Serial multivariable models examined association of Veteran status with behaviors, and changes in associations after inclusion of ACEs—OR for smoking before ACEs 1.84 (95% CI 1.18, 2.88) and after ACEs 1.57 (95% CI 0.96, 2.58); OR for drinking before ACEs 1.35 (95% CI 0.77, 2.36) and after ACEs 1.31 (95% CI 0.73, 2.35)	—	Diabetes, cardiovascular disease, asthma, and disability Serial multivariable models examined association of Veteran status with health outcomes, and changes in associations after inclusion of ACEs—no significant association between Veteran status and any outcome, except for disability, with OR before ACEs 1.83 (95% CI 1.08, 3.10) and after ACEs 1.57 (95% CI 0.90, 2.75)
Winkleby, 1993[137]	Residents of 3 National Guard Armories in Santa Clara, CA (1989-1990)	250 (0%, 41%, NR)	585 (0%, 45%, NR)	Self-reported childhood sexual or physical abuse	Sexual abuse: Veterans 6-8%, non-Veterans 5% (p=0.33) Physical abuse: Veterans 15-16%, non-Veterans 12% (p=0.27)	—	—	—

Author, Year	Data Source (Year)	*N* Participants (% Women, % Non-White, Mean Age)		Social Determinant		Role of Social Determinant in:		
		Veterans	Non-Veterans	Main Measure(s)	Prevalence, Degree, or Level	Health Behaviors	Health Services Access/ Utilization	Health Outcomes
Katon, 2015[70]	BRFSS (2011-2012), states with ACEs module	13321 (8%, 17%, NR)	88295 (68%, 20%, NR)	ACEs	Stratified by sex— mean ACEs among women: Veterans 2.2, non-Veterans 1.6 (p<0.001) mean ACEs among men: Veterans 1.7, non-Veterans 1.3 (p<0.001) Patterns of higher prevalence among Veterans also generally true for specific items	Smoking and binge drinking Multivariable analyses modeling association between number of ACEs and behaviors, stratified by sex and Veteran status, generally very small significant effects (RR range 1.04-1.14) in all groups, except for drinking in male Veterans (RR 0.95 [95% CI 0.82, 1.08])	—	QOL as self-perceived poor/fair health, days of poor physical health, and days of poor mental health Multivariable analyses modeling association between number of ACEs and QOL, stratified by sex and Veteran status, generally small significant effects in all groups (RR range 1.10-1.30); among men, also significant interactions between ACEs and Veteran status for all QOL outcomes
Sexual Orientation								
Lehavot, 2014[80]	NHANES (1999-2010)	151 (100%, 52%, 41 y)	8,738 (100%, 48%, 40 y)	Self-reported minority sexual orientation (*ie,* non- heterosexual)	Minority sexual orientation: Veterans 7%, non-Veterans 5% (p=0.51)	—	—	—
Trauma & Sexual Orientation								

Author, Year	Data Source (Year)	*N* Participants (% Women, % Non-White, Mean Age)		Social Determinant		Role of Social Determinant in:		
		Veterans	Non-Veterans	Main Measure(s)	Prevalence, Degree, or Level	Health Behaviors	Health Services Access/ Utilization	Health Outcomes
Lehavot, 2016[82]	WHI (1993-2014)	3433 (100%, 11% 64 y)	134206 (100%, 15%, 60 y)	1) Self-reported minority sexual orientation (*ie,* non-heterosexual) 2) Physical abuse, verbal abuse, or "other trauma" in past year	Sexual minority: Veterans 4%, non-Veterans 1% Physical abuse: sexual-minority Veterans, heterosexual Veterans and non-Veterans all 1%, sexual-minority non-Veterans 2%(p=0.004) Verbal abuse: Veteran groups both 10%, heterosexual non-Veterans 11%, sexual minority non-Veterans 15% (p < 0.001) "other trauma": sexual minority Veterans 7%, heterosexual Veterans 8%, sexual minority non-Veterans 10%, heterosexual non-Veterans 7% (p < 0.001).	—	—	All-cause mortality (fully adjusted models): Veteran status HR 1.14 (95% CI 1.06, 1.22) Sexual minority status HR 1.20 (95% CI 1.07, 1.36) Separate models examined role of trauma in 4 groups defined by Veteran status and sexual orientation: no significant HR for physical abuse except among heterosexual non-Veterans (HR 1.17 [95% CI 1.02, 1.33]), no significant HR for verbal abuse in any group, and no significant HR for "other trauma" except among sexual minority Veterans (HR 4.31 [95% CI 1.38, 3.47])

ACEs=Adverse Childhood Experiences (11 items); BRFSS=Behavioral Risk Factor Surveillance System; HR=hazard ratio; IPV=intimate partner violence; MCBS=Medicare Current Beneficiary Survey; MEPS=Medicare Expenditure Panel Survey; MSA=Metropolitan Statistical Area (US Office of Management and Budget); NR= not reported;

NHANES= National Health and Nutrition Examination Survey; NHIS=National Health Interview Survey; NLSY=National Longitudinal Survey of Youth; NSDUH=National Survey on Drug Use and Health; PHQ-8=Patient Health Questionnaire (8 items); QOL= health related quality of life; RR=relative risk; RUC=Rural-Urban Continuum (US Department of Agriculture); WHI= Women's Health Initiative

Appendix C, Table 3. Summary of Characteristics for Included Articles on Veterans Engaged and Not Engaged in VHA Services

Social Determinant	Total Articles	N > 1000	Study Design		Role of Social Determinant in:		
			Cohort	Cross-Sectional	Health Behaviors	Health Services Access or Utilization	Health Outcomes
Education	25	21	4	21	1	8	5
Marital Status	23	19	3	20	0	9	3
Income	27	23	3	24	1	9	5
Employment	21	15	3	18	1	6	2
Rurality	13	9	9	4	0	2	2
Trauma History	6	2	0	6	0	0	0
Social Support	2	2	0	2	0	0	0
Family Socioeconomic Status	2	2	0	2	1	0	1
Justice System Involved	2	0	0	2	0	1	0
Housing Status	3	3	1	2	0	0	0
Sexual Orientation & Gender Identity	0	0	0	0	0	0	0
Financial Barriers to Healthcare	0	0	0	0	0	0	0

Appendix C, Table 4. Detailed Results and Characteristics of Included Articles Addressing Rurality, Trauma, and/or Sexual Orientation for Veterans Engaged and *Not* Engaged in VHA Care

Author, Year	Data Sources (Year), Definition of Engaged	*N* Veterans (% Women, % non-White, Mean Age)		Social Determinant		Role of Social Determinant in:		
		Engaged	*Not* Engaged	Main Measure(s)	Prevalence, Degree, or Level	Health Behaviors	Health Services Access/ Utilization	Health Outcomes
Rurality								
West, 2006[129]	BRFSS (2000), self-reported VHA utilization in past year	1928 (0%, 21%, NR)	12461 (0%, 11%, NR)	Metropolitan= RUC codes 1-3; non-metropolitan= RUC codes 4-9	Non-metropolitan: Engaged 30%, not engaged 24%	—	"*Regardless of age or VA patient, other Veteran, or non-Veteran status, metropolitan residents (80.7% overall) were slightly more likely than nonmetropolitan ones (78.6%) to have had a checkup within the past 2 years (P < .01).*"	"[M]*etropolitan-nonmetropolitan residence factor did not yield significant effects…*" [on days of poor physical or mental health, or health limiting activities]
Kramer, 2016[74]	IHS and VHA data (2001-2003), only VHA utilization (vs only IHS)	18336 (8%, 100%, 56 y)	30023 (7%, 100%, 53 y)	Rurality based on RUC	Rural: Engaged 18%, not engaged 28%	—	—	—
McCarthy, 2009[91]	VA National Psychosis Registry and VHA utilization data (FY 2001-2004), use of intensive outpatient mental health case management	452 (12%, 44%, 56 y)	6088 (7%, 43%, 52 y)	Calculated straight-line miles from "population centroid" of zip code of residence to nearest VHA facility with intensive case management team	Median miles to nearest VHA case management team: Engaged 16, not engaged 46	—	—	—
French, 2012[40]	VHA and Medicare fee-for-service (2007), cataract surgery at VHA	20191 (2%, 12%, NR*)	137726 (8%, 7%, NR*)	4 categories based on zip code approximations of census RUCA codes:	Isolated small rural town: Engaged 8%, not engaged 8%	—	—	—

Author, Year	Data Sources (Year), Definition of Engaged	*N* Veterans (% Women, % non-White, Mean Age)		Social Determinant		Role of Social Determinant in:		
		Engaged	*Not* Engaged	Main Measure(s)	Prevalence, Degree, or Level	Health Behaviors	Health Services Access/ Utilization	Health Outcomes
	(vs Medicare paid) among dual enrollees			1) urban, 2) large rural city/town, 3) small rural town, 4) isolated small rural town	Small rural town: Engaged 9%, not engaged 9%			
Blackstock, 2012[19]	VHA data (FY 2002-2009), any use of VHA homeless services	7431 (13%, 51%, NR)	445319 (12%, 38%, NR)	Rural= all 3 non-urban categories based on zip code approximations of census RUCA codes	Rural: Engaged 15%, not engaged 21%	—	—	—
Kramer, 2011[75]	IHS and VHA data (FY 2002-2003), only VHA utilization (vs only IHS)	6947 (unable to abstract due to extensive errors in data table)	6500 (unable to abstract due to extensive errors in data table)	Rurality based on RUC	(unable to abstract due to extensive errors in data table)	—	—	—
Houston, 2013[63]	Pew Research Center's Internet & American Life Project (2010) , self-reported VHA utilization in past year	92 (16%, 36%, NR)	261 (9%, 25%, NR)	Self-reported rural vs urban status	Rural: Engaged and not engaged both 18%	—	—	—
French, 2012[41]	VHA and Medicare fee-for-service (2008), radiation therapy at VHA (vs Medicare paid) among dual enrollees	4646 (1%, NR, NR*)	137726 (2%, NR, NR*)	4 categories based on zip code approximations of census RUCA codes: 1) urban, 2) large rural city/town, 3) small rural town, 4) isolated small rural town	Isolated small rural town: Engaged 6%, not engaged 7% Small rural town: Engaged 6%, not engaged 8%	—	—	—

Author, Year	Data Sources (Year), Definition of Engaged	*N* Veterans (% Women, % non-White, Mean Age)		Social Determinant		Role of Social Determinant in:		
		Engaged	*Not* Engaged	Main Measure(s)	Prevalence, Degree, or Level	Health Behaviors	Health Services Access/ Utilization	Health Outcomes
Gorman, 2016[48]	Survey of National Guard soldiers in Michigan (2011-2013), utilization of any VHA mental health services	327 (7%, 23%, NR)	1099 (9%, 15%, NR)	Rural=non- MSA	Rural: Engaged 14%, not engaged 16%	—	—	—
West, 2009[130]	MEPS (1996-2004), self-reported VHA utilization	4990 (0%, NR, NR)	7698 (0%, NR, NR)	Rural=non- MSA	Rural: Engaged 27%, not engaged 23%	—	*"*[S]*ignificant main effects* [on total expenditures] *for Veteran-VA user status (p<.001 for either younger or older men) and its interaction with urban-rural residence (p<.05 for younger men; p<.01 for older men…)"*	—
Hynes, 2007[66]	VHA, VBA, and Medicare fee-for-service (1997-1999), utilization of only VHA (vs only Medicare-paid) outpatient services	270993 (2%, NR, NR*)	524678 (2%, NR, NR*)	Rural or urban using VHA classification	Rural: Engaged 21%, not engaged 19%	—	—	—
Ajmera, 2011[14]	MCBS (2001-2005), at least 1 hospital-ization, >1/3 outpatient visits, or >1/3 prescriptions paid by VHA	NR (unclear # participants)	NR (unclear # participants)	Non-metro= non-MSA	Unable to abstract due to unclear # participants	—	—	Neither VHA use nor non-metro residence were significantly associated with odds of having any hospitalization due to ambulatory care sensitive conditions
Trauma								

Author, Year	Data Sources (Year), Definition of Engaged	*N* Veterans (% Women, % non-White, Mean Age)		Social Determinant		Role of Social Determinant in:		
		Engaged	*Not* Engaged	Main Measure(s)	Prevalence, Degree, or Level	Health Behaviors	Health Services Access/ Utilization	Health Outcomes
Lehavot, 2015[81]	Internet survey of women Veterans with over-sampling of lesbian and bisexual population (2013), self-reported VHA use in past year	339 (100%, 17%, 47 y)	278 (100%, 13%, 52 y)	Self-reported childhood abuse, non-military adult sexual assault or physical victimization, military combat, military sexual harassment, assault, or physical victimization	Childhood abuse: Engaged 68%, not engaged 67% Non-military adult sexual assault: Engaged 41%, not engaged 28% (p <.001) Non-military adult physical victimization: Engaged 73%, not engaged 55% (p <.001) Military sexual harassment: Engaged 81%, not engaged 68% (p <.001) Military sexual assault: Engaged 48%, not engaged 28% (p <.001) Military physical victimization: Engaged 66%, not engaged 43% (p <.001)	—	—	—
Hamilton, 2013[52]	National Survey of Women Veterans (2008-2009), self-reported	2065 (100%, 35%, NR)	626 (100%, 26%, NR)	Self-reported military sexual assault	Military sexual assault: Engaged 20%, not engaged 9% (p=.002)	—	—	—

Author, Year	Data Sources (Year), Definition of Engaged	*N* Veterans (% Women, % non-White, Mean Age)		Social Determinant		Role of Social Determinant in:		
		Engaged	*Not* Engaged	Main Measure(s)	Prevalence, Degree, or Level	Health Behaviors	Health Services Access/ Utilization	Health Outcomes
	current VHA use							
Gamache, 2000[45]	Survey of homeless Veterans in 9 states (1995-1998), self-reported ever VHA use	390 (8%, 54%, 44 y)	308 (8%, 46%, 41 y)	Vietnam war-zone service	Vietnam war-zone: Engaged 32%, not engaged 16% ($p < .001$)	—	—	—
Ryan, 2015[108]	Survey of women OEF/OIF/OND Veterans in VISN 1 (2013-2014), self-reported current VHA use	49 (100%, 12%, 36 y)	82 (100%, 23%, 37 y)	Combat trauma by 17-item Combat Experiences Scale (CES) and 13-item Aftermath of Battle Scale (ABS); military sexual trauma by 8-item Sexual Harassment Scale (SHS)	Combat trauma: Engaged mean CES 25 (SD=12) and mean ABS 27 (SD=17), not engaged mean CES 21 (SD=6) and mean ABS 22 (SD =12), p=.04 for CES and p<.001 for ABS Military sexual trauma: Engaged mean SHS 2 (SD=4), not engaged mean SHS 0.8 (SD=2)	—	—	—
Rurality & Trauma								
Ouimette, 2003[100]	National sample from NRWV (1997), self-reported VHA use in past 2 y vs no use ever	543 (100%, 31%, NR)	529 (100%, 31%, NR)	1. Self-reported residence in city/suburb, large town, or small town/rural area 2. Combat, military sexual harassment, military sexual	Small town/rural: Engaged 6%, not engaged 7% Combat: Engaged and not engaged, both 8%	—	—	—

Author, Year	Data Sources (Year), Definition of Engaged	*N* Veterans (% Women, % non-White, Mean Age)		Social Determinant		Role of Social Determinant in:		
		Engaged	*Not* Engaged	Main Measure(s)	Prevalence, Degree, or Level	Health Behaviors	Health Services Access/ Utilization	Health Outcomes
				assault, "other military trauma"	Sexual harassment: Engaged 47%, not engaged 45% Sexual assault: Engaged 21%, not engaged 15% "other military trauma": Engaged 60%, not engaged 61%			
Simpson, 2013[113]	Targeted survey of sexual minority and trans-gendered Veterans (2004-2005), self-reported lifetime VHA use	162 (35%, 12%, 47 y)	194 (27%, 12%, 44 y)	1. Self-reported residence in town with <50,000 population 2. Military *…interpersonal traumas perceived* [as being] *due to their sexual orientation…"*	Town < 50,000: Engaged 25%, not engaged 26% Military trauma related to sexual orientation: – Engaged 51%, not engaged. 43% (p <0.10).	—	—	—

BRFSS=Behavioral Risk Factor Surveillance System; CI=confidence interval; IHS= Indian Health Service; MEPS=Medicare Expenditure Panel Survey; MSA=Metropolitan Statistical Area (US Office of Management and Budget); NR= not reported; NRWV=National Registry of Women Veterans; OEF/OIF/OND=Operation Enduring Freedom/Operation Iraqi Freedom/Operation New Dawn (wars in Iraq and Afghanistan);RUC=Rural-Urban Continuum (US Department of Agriculture); RUCA=Rural-Urban Commuting Area (US Department of Agriculture); SD=standard deviation