QUERI

Suicide Risk Factors and Risk Assessment Tools: A Systematic Review

March 2012

Prepared for:
Department of Veterans Affairs
Veterans Health Administration
Quality Enhancement Research Initiative
Health Services Research & Development Service
Washington, DC 20420

Prepared by:
Evidence-based Synthesis Program (ESP) Center
Portland VA Medical Center
Portland, OR
Devan Kansagara, M.D., M.C.R., Director

Investigators:
Principal Investigators:
Elizabeth M Haney, M.D.
Maya Elin O'Neil, Ph.D., M.S.

Co-Investigators and Research Associates:
Susan Carson, M.P.H.
Allison Low, B.A.
Kimberly Peterson, M.S.
Lauren M Denneson, Ph.D.
Chandra Oleksiewicz, M.D.
Devan Kansagara, M.D., M.C.R.

VA HEALTH CARE Defining EXCELLENCE in the 21st Century

PREFACE

Quality Enhancement Research Initiative's (QUERI) Evidence-based Synthesis Program (ESP) was established to provide timely and accurate syntheses of targeted healthcare topics of particular importance to Veterans Affairs (VA) managers and policymakers, as they work to improve the health and healthcare of Veterans. The ESP disseminates these reports throughout VA.

QUERI provides funding for four ESP Centers and each Center has an active VA affiliation. The ESP Centers generate evidence syntheses on important clinical practice topics, and these reports help:

- develop clinical policies informed by evidence,
- guide the implementation of 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.

In 2009, the ESP Coordinating Center was created to expand the capacity of QUERI Central Office and the four ESP sites by developing and maintaining program processes. In addition, the Center established a Steering Committee comprised of QUERI field-based investigators, VA Patient Care Services, Office of Quality and Performance, and Veterans Integrated Service Networks (VISN) Clinical Management Officers. The Steering Committee provides program oversight, guides strategic planning, coordinates dissemination activities, and develops collaborations with VA leadership to identify new ESP topics of importance to Veterans and the VA healthcare system.

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

Recommended citation: Haney EM, O'Neil ME, Carson S, Low A, Peterson K, Denneson LM, Oleksiewicz C, and Kansagara D. Suicide Risk Factors and Risk Assessment Tools: A Systematic Review. VA-ESP Project #05-225; 2012.

This report is based on research conducted by the Evidence-based Synthesis Program (ESP) Center located at the Portland VA Medical Center, Portland OR funded by the Department of Veterans Affairs, Veterans Health Administration, Office of Research and Development, Quality Enhancement Research Initiative. The findings and conclusions in this document are those of the author(s) who are responsible for its contents; the findings and conclusions do not necessarily represent the views of the Department of Veterans Affairs or the United States government. Therefore, no statement in this article should be construed as an official position of the Department of Veterans Affairs. No investigators have any affiliations or financial involvement (e.g., employment, consultancies, honoraria, stock ownership or options, expert testimony, grants or patents received or pending, or royalties) that conflict with material presented in the report.

TABLE OF CONTENTS

EVIDENCE REPORT

INTRODUCTION

Suicide is a major public health concern in the United States (US), claiming over 36,000 lives each year and nearly 100 lives each day.[1] Suicide was the tenth leading cause of death in the US in 2009.[1] The rate is highest among 25 to 34 year-olds, for whom suicide is the second leading cause of death.[43] For each suicide death, there are approximately 25 suicide attempts, also referred to as incidents of suicidal self-directed violence.[44, 45] The lifetime risk of suicidal self-directed violence for the general US population is estimated to be between 1.9 and 8.7 percent.[45]

Among Veterans and current military, suicide is a national public health concern. Recent estimates suggest current or former military represent 20 percent of all known suicides in the US,[46] and the rate of suicides among Veterans utilizing Veterans Health Administration (VHA) services is estimated to be higher than the general population.[47, 48] Among active duty soldiers in the Army, Army Reserve, and Army National Guard, rates are increasing and reached 20.2 per 100,000 in 2008.[49] Veterans returning from the Iraq and Afghanistan conflicts, referred to as Operation Enduring Freedom/Operation Iraqi Freedom (OEF/OIF) Veterans, may be particularly at risk, although the limited available data has shown mixed results.[2, 3] The enormity of the problem has led to several major public health initiatives and growing interest in suicide and self-directed violence prevention.[50-53]

Approximately 32 percent of individuals make contact with a mental health care provider and 77 percent make contact with a primary care provider during the year prior to suicide.[54] In one Oregon study, 22 percent of Veterans who died by suicide had made contact with Veterans Affairs (VA) healthcare providers in the prior year.[55]

Although healthcare providers have an opportunity to identify at-risk individuals and engage them in treatment to reduce suicidal self-directed violence, many healthcare providers are uncertain how to assess for suicide risk.[56, 57] Several risk factors for suicide and suicidal self-directed violence have been identified, most notably older age, male gender, physical and mental health disorders (including depression and substance use disorders), familial and genetic influences, impulsivity, poor psychosocial support, and access to and knowledge of firearms.[56, 58-60] Several psychological autopsy studies of the events leading up to suicide have suggested the majority of individuals who die by suicide exhibit symptoms of depression or other mental health issues prior to death.[61]

The relative importance of some of these traditional risk factors, as well as the influence of population-specific risk factors, may be unique among military personnel and Veterans. The prevailing male demographic, along with high rates of post-traumatic stress disorder (PTSD), substance use disorders, and other mental health disorders, may especially contribute to the risk of suicidal self-directed violence in military and Veteran populations. In addition, several aspects of military experience can increase the risk for mental health and substance abuse, which in turn are risk factors for suicide.[62] Other risk factors unique to the military experience could also contribute to overall suicide risk, including military rank, combat exposure, traumatic brain injury (TBI),[22, 63] habituation to violence,[64] and deployment-related stressors (e.g., strained or

long distance relationships, relocation, post-deployment adjustment).[60, 65]

Of course, many military and Veteran personnel will have one or more of these individual risk factors, but relatively few of them are truly at-risk for suicidal self-directed violence. Suicide risk assessment tools need to account for the relationship among these different risk factors and identify risk factors or combinations of risk factors that are particularly associated with suicidal self-directed violence. To be practically useful, risk assessment tools would identify a threshold beyond which preventive action should be taken and be brief enough to be conducted in primary care settings where many of the at-risk persons may be seen. Ideally, such tools would identify all persons truly at-risk for suicidal self-directed violence (i.e., have high sensitivity), while minimizing misidentification of persons who are not truly at high-risk (i.e., high specificity) because subsequent preventive therapies may be time-consuming and costly. Risk assessment tools should be able to, in other words, discriminate those at high- and low-risk for suicidal self-directed violence. Given the rarity of suicide, this can be a difficult task. Estimates by Gaynes et al. suggest that under base-case scenario, with an assessment tool with 0.80 sensitivity and 0.70 specificity applied to 10,000 patients (10 of whom will attempt suicide),[5] will have a positive predictive value of 0.3 percent (8 true-positives, 2 false-negatives and 2,997 false-positives). Using a tool with 0.89 sensitivity raises the positive predictive value to 3.8 percent.[5] These challenges require an enhanced understanding of suicide risk assessment in military and Veteran populations. The objectives of this review, therefore, are to review the available evidence for risk factors and assessment tools developed for use in healthcare and other community settings, and tested with Veteran and military populations.

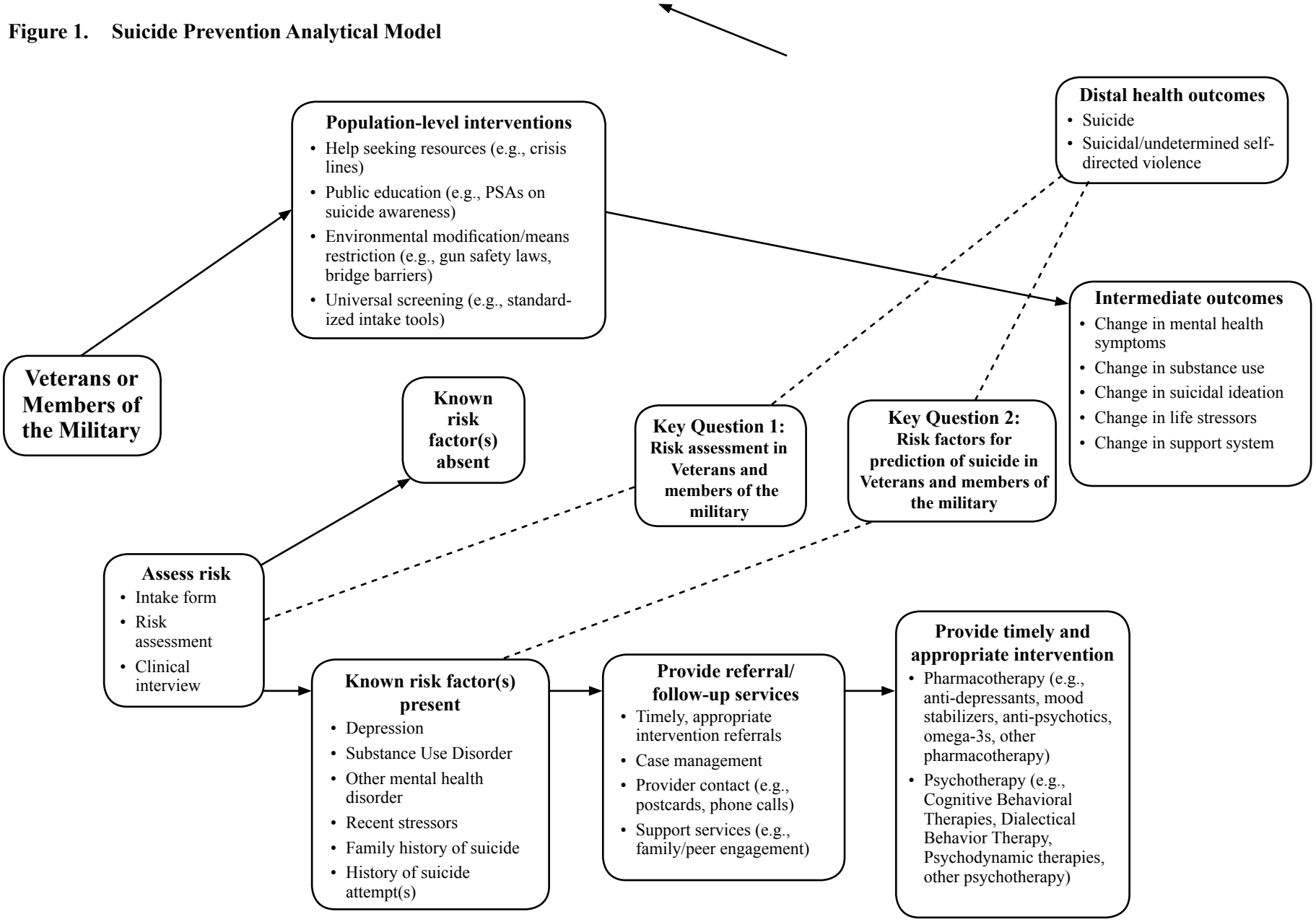
ANALYTICAL FRAMEWORK AND SCOPE OF THIS REPORT

In order to provide evidence for clinical practice guideline development, this report reviews available evidence about risk factors and risk assessment tools within Veteran and military populations.

The model below (Figure 1) summarizes the analytical framework used in this report for Veteran and military populations. We focus on individual-level risk factor determination and assessment; that is, clinically relevant risk factors that can help a provider determine that a patient has increased risk, and assessment tools that are appropriate for clinical risk assessment to predict suicide outcomes. Though the focus of the report is on suicide prevention, we include as outcomes any type of suicidal self-directed violence defined as, "Behavior that is self-directed and deliberately results in injury or the potential for injury to oneself. There is evidence, whether implicit or explicit, of suicidal intent."[66, 67] We use this terminology throughout this evidence report when possible; however, when describing results from primary studies, we use terminology as reported in the original articles in order to describe outcomes consistent with the primary studies.

Return to Contents

Figure 1. Suicide Prevention Analytical Model



Return to Contents

METHODS

TOPIC DEVELOPMENT

This project was requested by the VA/Department of Defense (DoD) Evidence Based Practice Working Group (EBPWG) to support the development of clinical practice guidelines for suicide prevention. The VA/DoD suicide prevention EBPWG requested a systematic review of literature related to suicidal self-directed violence as defined by Crosby et al. and Brenner et al.[66, 67] published since two prior reports on the topic by Mann et al. and Gaynes et al.[4, 5] The workgroup requested a review that focuses on countries and populations most representative of US Veteran and military populations.

A report on self-harm was recently conducted by the National Institute for Health and Clinical Excellence (NICE) and released in draft form during the writing of this current report.[6] The NICE report focuses on self-harm in general within the civilian population. Our report examines suicidal self-directed violence specifically rather than self-harm in general, and focuses on US Veterans and members of the military rather than on a civilian population. To be comprehensive, we summarize findings from the earlier (Mann and Gaynes) and concurrent (NICE) reviews in our report to highlight broader, civilian-focused evidence, though our report focuses on evidence specifically related to Veterans and members of the military. A technical panel comprised of members of this workgroup as well as VA leaders in the field of suicidology provided input.

The final key questions developed a priori in conjunction with the EBPWG are:

Key Question #1. What assessment tools are effective for assessing risk of engaging in suicidal self-directed violence in Veteran and military populations?

Key Question #2. In addition to the risk factors included by current assessment tools, what other risk factors predict suicidal self-directed violence in Veteran and military populations?

SEARCH STRATEGY

To identify relevant systematic reviews and controlled trials, we searched PubMed, PsycINFO, the Cochrane Database of Systematic Reviews®, and the Cochrane Central Register of Controlled Trials®. We used a similar search strategy as Mann et al.,[4] and covered the period from January 2005 to November 18, 2011 to identify newer studies that would not have been included in this prior review. We also included risk assessment, screening and validity, and Veteran populations as search terms (Appendix A). We limited the search to peer-reviewed articles involving human subjects and published in the English language that were not included in previously published systematic reviews on the topic.[4, 5] We obtained additional articles from systematic reviews, reference lists of pertinent studies, reviews, editorials, and consulting experts. Additionally, though the focus of the requested review was on risk factors and assessment tools related to suicide, we included any articles reporting on suicidal self-directed violence as an outcome to include as comprehensive a list of articles as possible.

STUDY SELECTION

Titles and abstracts were reviewed by doctoral level investigators and project research associates trained in the critical analysis of literature. Eligibility of full-text articles was independently assessed by two reviewers, and disagreements were resolved by consensus.

To determine the evidence base for the assessment of risk for engaging in suicidal self-directed violence and identifying additional risk factors for suicidal self-directed violence, we examined studies with any design, including systematic reviews, randomized controlled trials, observational studies and case control analyses. Assessment of new or emerging risk factors requires evaluation within the context of previously known risk factors. Some new risk factors may act through or as a result of other existing risk factors. Thus, controlling for known risk factors is an essential part of any study that seeks to propose a new clinical risk factor.[68] As such, we have included here only studies that evaluate risk factors using analytic techniques that account for at least one of several well-established risk factors (established a priori): suicidal ideation, history of suicide attempts, substance use disorder, or history of any mental health diagnosis. Therefore, studies that only reported rates of suicide in a general population were excluded; however, studies reporting rates of suicide in a population of people who all had prior substance use disorders or mental health diagnoses were included. Likewise, if a study enrolled patients from a randomized controlled trial and failed to control for treatment allocation, it was excluded. We excluded studies that used genetic testing to predict suicide, and studies that evaluated post-mortem tissue to assess biochemical or pathologic correlates with suicide. Our review was designed to detect the highest quality recent evidence relating to populations that most closely approximate US Veteran and military populations. Therefore, though we used selection criteria similar to those used in the reviews by Mann et al., Gaynes et al., and NICE 2011,[4-6] our review differs from these reviews in excluding research conducted in countries dissimilar to the US, and excluding studies on civilian populations. Additionally, the NICE report addresses primarily risk assessment and risk factors related to repetition of self-harm.

Below are listed the specific inclusion criteria used to select studies for each Key Question, respectively:

- Key Question #1 – Primary literature review of studies with the following characteristics:
- Patients: Any Veteran and/or military patient subgroup from the US, United Kingdom (UK), Canada, New Zealand, and Australia.
- Intervention: Not applicable to this key question.
- Comparator: No intention to limit by comparator.
- Outcomes and measures: (1) Proportion of individuals in each risk group who exhibit suicidal self-directed violence, including suicide attempt and suicide and not including self-directed violence ideation and undetermined or non-suicidal self-directed violence (i.e., behavior resulting in injury for which there is *unclear or no implicit or explicit evidence of intent to die*); and (2) standard measures of discrimination and reclassification for risk assessment tools.
- Timing: Any length of follow-up.
- Setting: US Veteran or military inpatient or outpatient setting.

Key Question #2 – Primary literature review of studies with the following characteristics:

- Patients: Any Veteran and/or military patient subgroup from the US, UK, Canada, New Zealand, and Australia.

- Intervention: Not applicable to this key question.
- Comparator: No intention to limit by comparator.
- Outcomes and measures: Proportions or relative risk (RR) ratios for suicidal self-directed violence, including suicide attempt and suicide and not including self-directed violence ideation and undetermined or non-suicidal self-directed violence (i.e., behavior resulting in injury for which there is *unclear or no implicit or explicit evidence of intent to die*).
- Timing: Any length of follow-up.
- Setting: US Veteran or military inpatient or outpatient setting.
- The complete study selection form, including abstract and full-text codes, is included in Appendix B.

DATA ABSTRACTION

For controlled trials, we abstracted information on setting, population characteristics, risk factors measured or included in assessment tool, comparison group (if any), number of subjects, length of follow-up, outcome assessment methods, and results. For systematic reviews, we abstracted information on the objective of the review, time period and databases searched, excluded studies and eligibility criteria used; and for all included studies that also met our eligibility criteria, we also abstracted information on study designs, country, sample size, population, and main results. For observational studies analyzing assessment tools, we abstracted information on study design, population and setting, outcome, risk factor included in assessment calculation, results, results of validation in a second group, and appropriateness for primary care settings. For observational studies assessing risk factors, we abstracted information on study design, aim of the study, sample size, data source and sample time frame, population characteristics, comparison group (if any), risk factors measured, method of measurement of risk factors and outcome, length of follow-up/observational, statistical analysis methods/control for confounding, and results.

QUALITY ASSESSMENT

We assessed the quality of systematic reviews using predefined criteria established by Oxman and Guyatt in 1991.[8] The Oxman and Guyatt quality rating system consists of nine questions that involve assessing the adequacy of systematic review methods including searching, reporting of inclusion criteria, study selection, validity assessment, data synthesis, and conclusions. Each question is scored as 'yes,' 'partially/unclear,' or 'no'. The overall quality is scored based on a scale of 1 to 7, where 1 represents the presence of extensive flaws and 7 represents the presence of minimal flaws (Appendix C).

We assessed the risk of bias of primary studies using modified versions of the tools described in Harris et al. 2001 and Hayden et al. 2006.[9, 10] Adequacy for each domain was rated as 'yes,' 'unclear/unsure,' or 'no.' The overall risk of bias for each controlled trial is then rated as 'low,' 'unclear,' or 'high' based on the reviewer's judgment of the plausibility that the biases have seriously weakened their confidence in the results (Appendices D and E).

Two reviewers independently assessed the quality of each study. Reviewers then compared their ratings and resolved all differences through discussion or by consulting a third party when consensus could not be reached. Note that it is possible for a study that is included in both

the risk assessment tool section and the risk factor section (example, Hartl 2005) to be rated differently for risk of bias as the evidence pertains to each section because of differences in the risk of bias criteria for risk assessment studies versus risk factor studies. Domains for risk factor studies included: adequacy of population description, non-biased selection, minimal loss to follow-up, adequate (un-biased) risk factor assessment, adequate (un-biased) outcome measurement, adequate sample size (number of outcome events), adequate statistical adjustment, and number of confounders adjusted for in the analysis (must have adjusted for at least 1 of 4 necessary risk factors – any mental health diagnosis, history of suicide attempt, suicidal ideation or substance abuse). Domains for risk assessment tool studies included: adequate population description, non-biased selection, minimal loss to follow-up, standardized method of risk factor assessment and scoring clearly described, unbiased risk factor assessment by independent assessors, adequate outcome measurement, unbiased outcome measured by independent assessors, and adequate accounting for potential confounders.

DATA SYNTHESIS

We constructed evidence tables showing study design, population and setting, and risk factor measured or included in assessment; methodological quality; and outcomes, organized by key question and study design. We analyzed studies to compare their characteristics, methods, and findings. For risk assessment tools, we graded strength of evidence based on the guidance established for the Evidence-based Practice Center Program of the Agency for Healthcare Research and Quality.[69] We compiled a summary of findings for each key question and study design based on qualitative synthesis of the findings. The heterogeneity in study population, tool characteristics, and patient population among studies precluded meaningful quantitative analysis. For risk factor studies, we summarized the studies in a table displaying population, outcome and risk of bias (Table 2); we compiled the evidence about risk factors into a table that lists the strength of evidence according to each risk factor (Table 1).

We also report findings as described in the prior systematic reviews by Mann et al. and Gaynes et al.[4, 5] Because our review was designed to be an update to these reports and because of different scopes of the reports, we have not re-evaluated the source studies included in their reports. Additionally, we include in our synthesis findings from the NICE 2011 draft report on self-harm,[6] a review with a similarly up-to-date literature search to this current report, though a more broad focus on self-harm in all populations including civilians. Due to the differences in scope and methods in these other reports, data synthesis of their findings is limited to a qualitative summary of findings.

Our review was designed only to examine studies published since June, 2005, so we consider the findings from the Mann et al. and Gaynes et al. reviews to assess the contributions of pre-2005 literature on the overall strength of evidence.[4, 5] We also summarize the information on repeated self-harm (including suicide) reported in the NICE 2011 review.[6] However, because these reviews used different quality assessment and data synthesis methodology, as well as having different scopes (e.g., including civilian populations, or focusing on repeated self-harm), the combination of results from the reports should be interpreted with caution.

PEER REVIEW

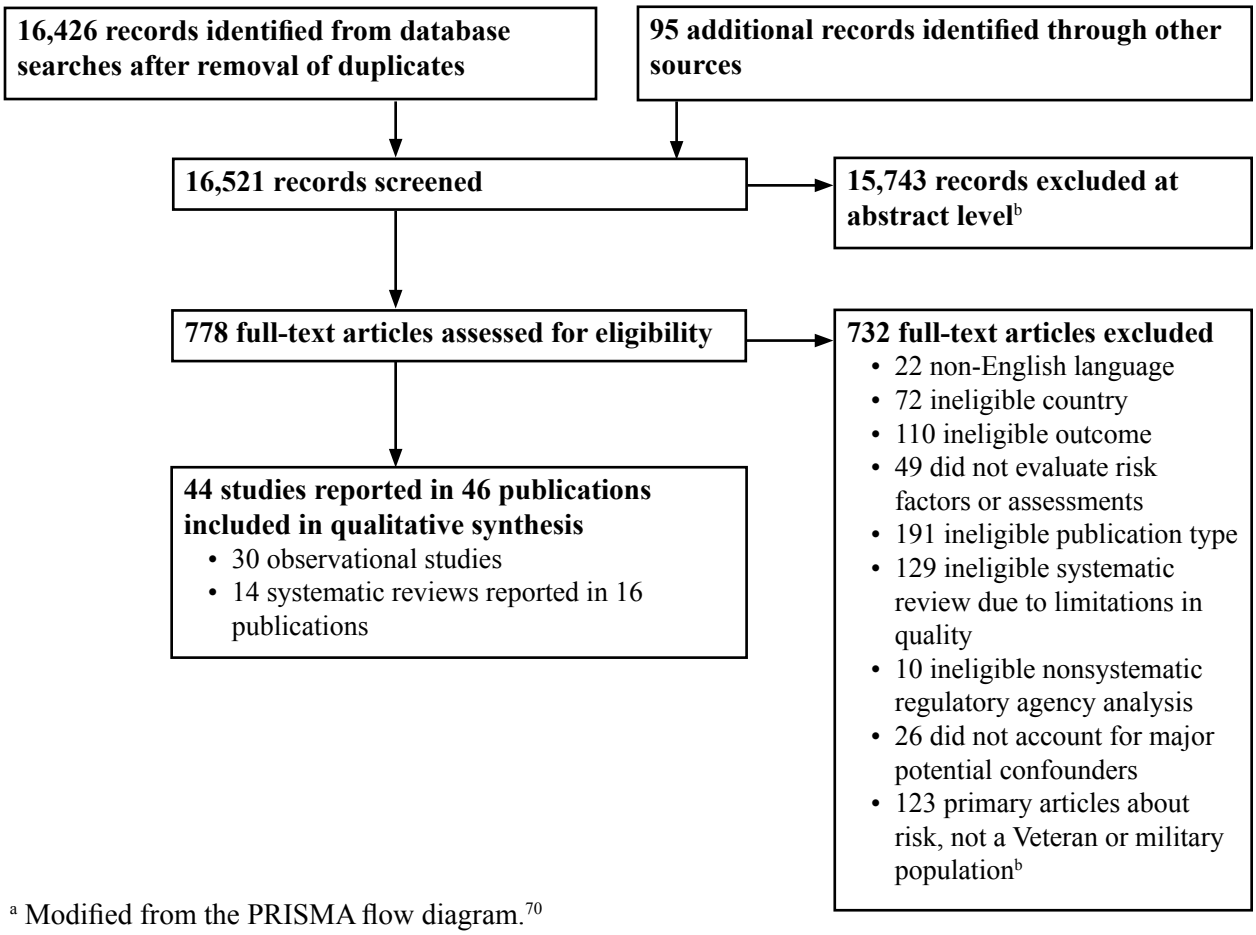
A draft version of this report was reviewed by seven technical experts as well as clinical leadership. Their comments and our responses are presented in Appendix M.

RESULTS

LITERATURE FLOW

We reviewed 16,426 titles and abstracts from the electronic search, and an additional 95 from reference mining for a total of 16,521 references. After applying inclusion/exclusion criteria at the abstract level, 15,743 references were excluded. We retrieved 778 full-text articles for further review and another 732 references were excluded. We identified a total of 46 references for inclusion in the current review, including 30 observational studies and 14 systematic reviews (reported in 16 publications). We grouped the studies by key question and study design. Figure 2 details the number of references related to exclusion criteria and publication type.

Figure 2. Literature Flow Chart[a]



[a] Modified from the PRISMA flow diagram.[70]

[b] 1,336 primary risk articles in a non-Veteran or military population were excluded after reviewing the publication's abstract; 123 were excluded after reviewing the full publication.

SYSTEMATIC REVIEWS

We identified 34 systematic reviews (reported in 38 publications) of risk assessment tools and risk factors associated with suicidal self-directed violence.[71-108] Using the Oxman and Guyatt criteria, we assessed these reviews for risk of bias (Appendix F).[8] Fourteen reviews had minimal flaws (a rating of 6 or 7); these are summarized in Appendix G.[74, 76, 79, 83, 86, 88, 89, 91, 94-97, 104, 105, 107, 108] The usefulness of these reviews to this report is limited, however; 6 of 14 reviews did not include any studies meeting our eligibility criteria, and no review focused on Veteran or military populations.

KEY QUESTION #1. What assessment tools are effective for assessing risk of engaging in suicidal self-directed violence in Veteran and military populations?

Summary of prior reviews on risk assessment tools in non-Veteran and non-military populations

In order to provide background on the literature prior to 2005 and in civilian populations, we highlight findings from several existing reviews on suicide assessment tools in any population. These reports include systematic reviews of suicide by Mann et al., Gaynes et al., and one on repetition of self-harm by NICE in 2011;[4-6] as well as two non-systematic literature reviews that provide comprehensive lists of over 60 existing suicide assessment tools for adults and older adults by Brown, and for children and adolescents by Goldston.[11, 12]

Brown and Goldston[11, 12] are non-systematic reviews that describe the psychometric properties and validation studies for measures designed to assess suicidal ideation and behavior. The Brown report cites numerous measures that have demonstrated adequate internal reliability and concurrent validity, though it highlights the Scale for Suicidal Ideation and the Beck Hopelessness Scale as two of only very few measures that have shown associations with death by suicide. The Goldston paper reports that many promising measures for use in child and adolescent populations have insufficient psychometric data, and are in need of further research. Goldston specifically highlights the need for prospective studies examining the association between these assessment tools and death by suicide. Due to the non-systematic nature of the Brown and Goldston papers,[11, 12] and the fact that their specific inclusion criteria were different from the criteria used for our current review, findings should be interpreted as such, and not combined in an additive manner with findings from this report. However, researchers and providers seeking information on existing assessment tools will find these reports to be a resource for descriptive and validity information on such tools.

The three systematic reviews, Mann et al., Gaynes et al. and NICE 2011,[4-6] each highlight the need for further prospective research to establish the effectiveness of these assessment tools in predicting suicidal self-directed violence. The authors all note that current research is insufficient to determine definitively whether or not there is a benefit in implementing existing screening tools for the prevention of suicide. The NICE 2011 review is the most recent and comprehensive review of suicide risk assessment tools. It describes findings from six cohort studies that examine tools for prediction of death by suicide among people with prior non-fatal self-harm. The authors

conclude that several limitations of the whole body of literature preclude recommendation of these suicide risk assessment tools for use in clinical practice: short follow-up periods of the studies, inadequate sample sizes needed to detect effects on low base-rate outcome, and overall high rates of false positive identification of individuals as being at risk for suicide. This report also investigated scales designed to predict self-harm and described similar limitations among these scales. Specifically, they note that low positive predictive values for these scales indicate that individuals are likely to be over-identified as being at risk, which has the potential to result in unnecessary intervention for some individuals. Overall, the findings from the Mann, Gaynes, and NICE reviews concur in their reports of limited evidence available on the effectiveness of suicide risk assessment measures in prevention of suicidal self-directed violence. We summarize assessment results from these reports in Appendix H, describing the scope as well as the findings.

Primary studies of risk assessment tools in Veteran and military populations

Given the limited evidence available on effective suicide risk assessment tools, we examined the best available evidence specifically related to Veteran and military populations. We included five articles[13-17] that met our inclusions criteria and described assessment tools used within military or Veteran populations (Appendix I), three of which had methodological flaws resulting in a high risk of bias,[13, 14, 16] and two of which were rated as having unclear risk of bias (Appendix J).[15, 17]

Hendin et al. examined a brief screening tool, the Affective States Questionnaire (ASQ), as a predictor of suicidal behavior.[15] This study was conducted among a population of 283 Veterans receiving inpatient or outpatient services at a Veterans Affairs Medical Center (VAMC). The ASQ increased odds of prediction of future suicidal behavior by 2.4 in a logistic regression model adjusting for sex, substance abuse, and severity of depression. Using a cutoff of ≥3, the ASQ resulted in sensitivity of 0.60 and specificity of 0.74 in this population. The authors report preliminary validity information for the ASQ, and the study obtained a rating of unclear risk of bias because of insufficient information on how patients were selected to participate and no information on assessor blinding when assessing the suicidal behavior outcome. Because of the unclear risk of bias and relatively small sample size, this one study provides insufficient evidence that the ASQ predicts suicidal behavior. However, because of the initially promising results even after adjusting for known risk factors, as well as the potential utility of such a brief screening tool in primary care settings, future research on the predictive power of the ASQ is warranted.

Tiet et al. investigated the use of the Addiction Severity Index (ASI), a lengthy structured clinical interview designed to be used as an intake interview for a substance abuse treatment program.[17] Their study examined over 34,000 Veterans who were assessed for intake as part of substance abuse treatment at 150 VAMCs nationwide. This assessment tool is not ideal for settings that require brief screening tools, though VAs used to use this assessment routinely, and, therefore, the information is readily available in a large number of Veteran medical charts for those Veterans who received substance abuse treatment in the past. As such, the information provided in this article is helpful in establishing risk factors based on an entire population of Veteran responses to routine intake items within the timeframe covered in the study. The authors report a decision tree, delineating all significant risk factors to predict future suicidal behavior. The significant predictors were suicide attempt history, suicide ideation history, recent alcohol abuse, recent cocaine abuse, violent behavior, hallucinations, and employment status. This article was

rated as having an unclear risk of bias, largely because of the unclear independence of assessors; however, because of the large sample size (i.e., the entire population of Veterans who completed a structured and electronically documented substance abuse intake process), this single study provides moderate strength of evidence for the reported risk assessment capabilities of the ASI. As noted, however, the ASI is no longer routinely used in VA settings.

Breshears et al. investigated the use of the Personality Assessment Inventory (PAI) in a population of 154 Veterans with a history of TBI.[13] The PAI is a lengthy assessment tool designed to be administered by a psychologist in the context of an in-depth psychological assessment. Two PAI subscales are designed to assess aspects of suicidality, and these two subscales were investigated as predictors of future suicidal behavior as documented in patient's charts. Breshears evaluated one of the subscales of the PAI, the Suicide Potential Index (SPI), and found that it predicted suicidal behavior after controlling for other risk factors. Although this measure is frequently used in VA settings as part of psychological assessments, it is not well suited for use as a brief screening tool and, therefore, would be less useful in primary care settings. The lack of applicability to primary care settings is related to the lengthiness of the overall measure, the computer scoring methods, and the training/educational requirements required for interpretation and scoring. The various subscale items are embedded within the overall assessment tool, making partial administration of specific subscales difficult if not impossible. The results suggest potential additive predictive power of the SPI subscale. However, the high risk of bias rating of this study due to lack of assessor blinding and other methodological flaws does not allow for strong conclusions on the basis of this study. Although lack of assessor blinding may be less concerning with more objective outcomes such as suicide, this study used chart review to document suicide attempts, making lack of blinding a potential source of bias. More research to confirm these preliminary findings regarding the use of the SPI subscale would be necessary before recommending its use in a clinical setting.

Nademin et al. describe the Interpersonal Psychological Survey (IPS), a 34-item measure, which they report as being associated with increased odds of suicide (Odds Ratio [OR]: 1.27).[16] This study, however, was rated as having a high risk of bias due in large part to the inability to account for confounders and differences in assessment techniques between groups. The two groups they examined were 60 members of the Air Force who died by suicide and a matched sample of 122 members of the Air Force. Due to the retrospective nature of the study investigating suicide as the primary outcome, assessors estimated scores on the assessment tools for the groups of participants who died by suicide, whereas the control group participants completed the measures by self-report. This difference in assessment techniques and other confounders associated with the groups being compared results is insufficient evidence that the IPS predicts suicide.

Hartl et al. reported findings for a sample of 630 male Veterans diagnosed with PTSD and participating in a residential treatment program.[14] They examined the Beck Depression Inventory-II (BDI), a 21-item, commonly used depression screening tool which includes an item asking about suicidal ideation. This measure, due to its brevity, frequent usage, and ability to be administered, scored, and interpreted by a variety of providers, has potential for widespread implementation in VA and military settings. Though the authors found that previous suicide attempt (four months prior to intake) was the strongest predictor of future suicide attempt following discharge, they report that BDI-II score was also a significant predictor of

future suicide attempt. They reported model sensitivity of 0.63 and specificity of 0.80 in their exploratory sample of 409 Veterans. The replication study examining data on the remaining 221 Veterans used the cutoffs established in the exploratory study. Contrary to the exploratory model, the replication model resulted in sensitivity of 0.11 and specificity of 0.84. Overall, this study provides insufficient evidence for the BDI-II in predicting future suicide attempts in a Veteran population with PTSD due to the inconsistent results as well as the high risk of bias rating of this study.

KEY QUESTION #2. In addition to the risk factors included by current assessment tools, what other risk factors predict suicidal self-directed violence in Veteran and military populations?

Summary of prior reviews on risk factors for suicide in non-Veteran and non-military populations

Though existing systematic reviews on this topic were outside the scope of this report due to their focus on civilian populations, in order to provide a comprehensive report on risk factors for suicide, we highlight findings from existing systematic reviews of risk factors in any population. These include systematic reviews on suicide by Mann et al., Gaynes et al., and on repetition of self-harm by NICE in 2011.[4-6] Mann and Gaynes did not address literature assessing the strength of individual risk factors, but the NICE report did perform a comprehensive review and meta-analysis of risk factors. The NICE report methodology differs from that used for this report in several ways: 1) they included only prospective studies evaluating risk for repetition of self-harm; 2) they included studies from other countries outside the scope of this report; and 3) they included studies that were minimally adjusted for confounders (other risk factors that might explain the association - e.g., mental health diagnoses; some studies did not assess or adjust for mental health diagnoses in evaluating other risk factors for suicide).

The NICE report found that the following factors predicted non-fatal repetition of self-harm in adults:[6] prior self-harm and depression symptoms, schizophrenia and related symptoms, alcohol misuse, other psychiatric history, unemployment and "registered sick", female gender (mixed and poor quality evidence), unmarried status (narrative evidence only; not predictive in pooled analysis), and younger age. The following symptoms predicted suicide among adults with prior self-harm: suicide intent/intent to die, male gender, psychiatric history, older age, violent methods of self-harm, physical health problems (mixed evidence), and alcohol abuse (mixed evidence). Risk factors for repeated self-harm among young people were similar to those identified for adults. Given these differences between our report and the NICE review, these findings should be interpreted with some caution.[6]

Primary studies on risk factors for suicide in Veteran and military populations

We identified 26 studies that evaluated risk factors to predict suicide behavior outcomes (Appendix K).[14, 18-42] Table 1 in this section lists all risk factors identified and the studies that contributed to evidence for that risk factor. Table 2 lists all studies with information on study design, population, outcome and risk of bias for each included study.

Studies of risk factors for suicide were longitudinal, cross-sectional and case-control in their design. Many utilized existing VA databases linked with clinical (inpatient or outpatient), administrative, or large survey databases either alone or linked with another data sources. The populations represented in these studies are US Veterans in 18 studies, active duty US military personnel in four studies and other military populations in four studies. Outcomes include death by suicide in 15 studies, self-reported suicide attempts in 11 studies, and objective suicidal behavior assessed by chart review or clinician referral, or admission for suicide attempt in two studies.

Risk of bias for the 26 identified studies is included in Appendix L. Four studies had a high risk of bias and, therefore, are not discussed further in this report.[33, 34, 39, 40] The remaining 22 studies were rated as having unclear risk of bias. No studies had low risk of bias, a determination that requires that a study satisfy all quality criteria. Limitations of the studies evaluated here that accounted for high or unclear risk of bias include: assessment of suicidal behavior by chart review only, a method that is biased by whether the provider chooses to document suicidal behavior; use of ICD-9 codes for risk factor assessment; assessment of suicide attempts by self-report; failure to report specific details of recruitment process (how many screened, how many agreed to participate and actually provided data); failure to report on the handling of missing data; and recruitment of potentially biased study population (as in patient sample with non-random treatment assignment when medication is the risk factor). As explained in the Methods section, we excluded studies that had inadequate control for potential confounding variables and randomized controlled trials that did not account for treatment group. The remaining studies are reported below.

Studies that assess risk factors for self-reported suicide attempts

Longitudinal designs

Two studies that utilized a self-reported suicide attempt outcome were longitudinal.[14, 28] Hartl et al. enrolled male Veterans who were entering a residential treatment program for PTSD. Predictive variables were obtained at enrollment in the program and suicide attempts were assessed four months following discharge from the program. Having attempted suicide in the four months prior to enrollment was the best predictor of suicide attempt following discharge. Among those who had not attempted suicide in the four months before enrollment, suicide attempts following discharge were predicted by depressive symptoms (based on scores on the BDI).[14] No data are provided about how various levels of BDI scores predict suicide attempts.

Ilgen et al. reported on how the ASI[109] administered within two weeks of entry into a VA addiction treatment program predicted suicide one year later.[28] Factors that predicted suicide attempts were: elevated suicidal/psychiatric symptoms based on the ASI, alcohol problems, and cocaine-adjusted life years; protective factors were: involvement with the criminal justice system and the number of days of participation in substance use disorder treatment.[28] For this study, the authors used factor analysis to create the variable, "suicidal/psychiatric symptoms," by combining four other positively correlated and overlapping variables: number of psychiatric problems in the 30 days prior to baseline, number of previous inpatient psychiatric treatment episodes, whether the patient reported being on psychiatric medications at baseline, and a variable for lifetime suicidality that was derived from lifetime suicidal ideation and lifetime suicide attempts.

Cross-sectional designs

Five studies assessed self-reported suicide attempts using a cross-sectional study design and were rated as having unclear risk of bias.[18, 19, 36, 37, 42] Two of these used active duty military Canadian military personnel.[18, 19] Evaluating specific types of trauma, Belik et al. 2009 found that suicide attempts among men were associated with having purposely injured or killed, toxic chemical exposure, and life-threatening illness; and being a civilian in religious terror. Suicide attempts among women were associated with witnessing a man-made disaster, being a victim of child abuse or other abuse, witnessing domestic violence or being stalked.[18] In the second study, Belik at al. 2010 found that depressive episodes, social phobia, alcohol dependence, generalized anxiety disorder and PTSD were associated with increased odds of suicide attempt.[19]

Tiet et al. examined data from over 33,269 men seeking treatment for substance use disorders, psychiatric disorders or both from the VA healthcare system.[37] In multivariate logistic regression models of men, suicide attempt within the past 30 days was significantly associated with sexual abuse (OR 2.08) and physical abuse (OR 2.38) in the past 30 days, lifetime sexual abuse (OR 1.33) before the past 30 days, psychotic disorder (OR 1.48), depressive disorder (OR 2.38), PTSD (OR 1.37), other anxiety disorder (OR 1.45), and personality disorder (OR 1.74). Alcohol abuse or dependence, drug abuse or dependence, marital status, age, and lifetime physical abuse prior to the past 30 days were not significantly associated with suicide attempts.[37]

Thomsen et al. surveyed 2,116 active duty military personnel in the US Marine Corps and US Navy serving in the US, half of whom had been combat deployed, and questioned them about their behaviors: 1) as a civilian, 2) prior to combat deployment, and 3) subsequent to combat deployment.[36] Those who reported a prior suicide attempt had significantly higher odds of a subsequent suicide attempt (adjusted OR 8.58). Marital status (being divorced, separated or widowed) was the only other significantly associated potential risk factor (OR 3.90). This model included gender, age, rank, education, and combat deployment but no variable to account for psychiatric illness.[36]

Pettit et al. evaluated 298 men and women enrolling in an intervention trial for suicidality recruited from clinics, inpatient wards and the emergency room of a major US Army Medical Center.[42] This cross-sectional analysis was designed to evaluate the interaction between negative life events and very early onset psychiatric illness (bipolar disorder, anxiety and major depressive disorder [MDD]). Negative life events were associated with self-reported suicide attempts in those with very early onset anxiety, very early onset MDD, and those without any history of very early onset psychiatric disorder. The interaction term for negative life events and very early onset bipolar disorder was significant, suggesting that very early onset bipolar disorder accounts for the association between negative life events and self-reported suicide attempts in this group.[42]

Studies that assess risk for objectively measured suicide attempts

Two studies have assessed suicide attempts using an objectively measured outcome rather than self-report, both using retrospective study designs.

Retrospective Designs

Brenner et al. performed a case control study using Veterans with a history of suicide identified from electronic medical records (EMR) of a VA mental health clinic and age/gender matched

controls.[21] Having chart diagnoses of both PTSD and TBI increased the odds of suicide compared with those who had TBI only (OR 3.29), and increased the odds compared to having neither PTSD nor TBI (OR=2.54). In models accounting for both PTSD and TBI, PTSD was independently associated with suicide but TBI was not.[21] Thus, PTSD appears to be independently associated with suicide attempts, and also appears to increase the odds of a suicide attempt among patients with TBI.

Using a retrospective chart review of randomly selected medical charts from those admitted to a US Army hospital with suicidal behaviors (n=191), Cox et al. evaluated predictors of suicide behaviors.[23] Admission for suicidal behavior (as opposed to suicidal ideation) was associated with three types of childhood trauma (sexual abuse, domestic violence and other trauma). When this model was further adjusted for "other trauma," those associations were no longer significant and indeed this model resulted in no significant risk factors.[23] This study was assessed to have unclear risk of bias because all risk factors including trauma were evaluated with chart review.

Studies that assess risk factors for suicide

Thirteen studies evaluated risk factors for suicide. Many of these confirmed the suicide by using the National Death Index (NDI) to identify the person and cause of death; others used military records and International Classification of Diseases, Tenth Revision (ICD) chart diagnoses.

Longitudinal studies

Eleven studies with death by suicide as the outcome used a longitudinal analysis to assess the contribution of risk factors.[22, 24-27, 29, 30, 32, 35, 38, 41] Longitudinal analysis implies that the risk factor was known to occur prior to the outcome. In the case of a suicide death outcome, this will nearly always be the case, independent of whether the potential risk factors were assessed retrospectively (from charts after the time of the suicide) or prospectively (at baseline, prior to suicide). Prospective data collection contributes to lower risk of bias overall.

The studies in this group evaluated the following potential risk factors: PTSD, TBI, psychiatric diagnoses, severe pain, and two health services measures: quality of care measures from recent psychiatric admissions and timing of follow-up following discharge after psychiatric admission.

The studies with longitudinal analysis are reviewed in this section, grouped by their primary variable of interest. In most/all cases, other variables were also included and assessed.

Psychological factors. Several studies by Ilgen et al. evaluate psychological factors using distinct populations and methods. One of these studies utilized data from 3,291,891 Veterans who used VA services in fiscal year (FY) 1999 and were alive at the start of FY 2000 to evaluate associations between psychiatric diagnoses and risk of suicide over the next six years. They found that both male and female Veterans diagnosed with any psychiatric condition were more likely to die by suicide than their counterparts who had no psychiatric diagnoses (Hazard Ratio [HR] for males: 2.50; 95% Confidence Interval [CI], 2.38 to 2.64; HR for females 5.18; 95% CI, 4.08 to 6.58). Indeed, the risk of suicide was increased for those with alcohol abuse or dependence, drug abuse or dependence, bipolar disorder, depression, other anxiety, PTSD and schizophrenia (age adjusted models, HR higher for females than males in every instance). Ilgen et al. did not evaluate all psychiatric diagnoses together in a multivariate model.[25] This study was

determined to have unclear risk of bias based on lack of reporting of missing data and assessment of risk factors by use of ICD-9 codes.

Ilgen et al. evaluated Veterans with substance use disorders for predictors of violent compared with non-violent suicide compared to controls without suicide over four years (854 suicides and 4,228 controls). Major depression, other anxiety disorders, bipolar disorder, PTSD, schizophrenia, personality disorders and the presence of more than one mental disorder were predictive of both violent and non-violent suicide. Alcohol, cocaine, opiate, and multiple substance use disorders were associated with a higher risk of non-violent suicides compared to violent suicides. None of the factors evaluated were significant for prediction of violent suicide compared to non-violent among those who died by suicide.[26] This study was determined to have an unclear risk of bias based on lack of reporting of missing data and assessment of risk factors by the use of ICD-9 codes.

In a separate analysis, Ilgen et al. evaluated 887,859 patients from the VA's National Registry for Depression (NARDEP) for suicide risk factors, specifically race and substance abuse. Risk factors were evaluated between April 1999 and September 2004, and the suicide could have occurred at any time during the study period or in the one year following the study period (total follow-up time of up to 6.5 years, n=1892 suicides). African Americans were significantly less likely to die by suicide than individuals of any other race/ethnicity group. In African Americans with substance use disorder, no other variables were significantly associated with death from suicide. In non-African Americans (primarily white race), death from suicide was associated with having been admitted to an inpatient psychiatric ward in the 12 months prior to the suicide. In those without a substance use disorder, males had almost four times the rates of suicide compared to women.[27] This study used a replication cohort to validate their findings. All factors identified in the derivation cohort also significantly discriminated suicides from non-suicides in the validation/replication cohort.

Pfeiffer et al. used the same population of 887,859 Veterans with depression to evaluate other psychiatric diagnoses as potential risk factors for suicide. This study found that the odds of suicide were higher among patients with generalized anxiety disorder and anxiety disorder not otherwise specified, and those receiving anti-anxiety medication.[32] Interestingly, PTSD was a predictive factor in this population and several other psychiatric diagnoses were not significantly associated with depression (social phobia, obsessive-compulsive disorder [OCD], all other anxiety disorders).

Zivin et al. used data from 807,694 Veterans (NARDEP data linked with VA Medicare data and NDI; 1,683 suicides over a 5.5 year period) and Cox proportional hazards regression to evaluate PTSD as a risk factor. Among depressed Veterans, PTSD was inversely associated with suicide in the older but not younger depressed Veterans (interaction term PTSD x age ≥ 65 years HR 0.66; 95% CI, 0.44 to 0.99 versus [vs] PTSD x age 45-64 years HR 0.80; 95% CI, 0.58 to 1.01). Other significant predictors of suicide were white race, male gender, non-Hispanic ethnicity, history of substance abuse, younger age (18-44 years), non-service connectedness, and having a history of an inpatient stay for any psychiatric disorder in the previous 12 months.[41] This study was rated unclear risk of bias because of lack of information regarding missing data, and lack of reporting about coding process and blinding of raters.

Brenner et al. evaluated data from 7,850,472 Veterans being evaluated in the mental health system (49,626 suicides) with Cox proportional hazards regression models for time to suicide

adjusted for psychiatric comorbidities. In this population, 49,626 Veterans had traumatic brain injury (TBI), and 105 had TBI and suicide. To be eligible, Veterans had to have received care between FY 2001and 2006. Inpatient and outpatient notes were searched for a diagnosis of TBI. Data were linked to the NDI. They found that Veterans with any TBI were 1.55 more likely to die of suicide (HR 1.55; 95% CI, 1.24 to 1.92) compared to those without, after adjustment for age, gender, eight psychiatric diagnoses including substance use disorder, and Veteran Integrated Service Network. Patients with concussion or fracture were 1.98 times more likely to die of suicide; those with cerebral contusion or traumatic intracranial hemorrhage were 1.24 more likely.[22] This study was rated as having unclear risk of bias because of lack of information regarding missing data, lack of reporting about coding process and blinding of raters.

Kaplan et al. assessed Veteran status and psychiatric diagnoses using data from US Veterans from the National Health Interview Survey data between 1986-94, linked ot the Multiple Casuse of Death file throug the NDI (1986-97, n=320,890 men followed for up to 12 years). This study demonstrated that Veterans in the US had increased risk of suicide regardless of whether they were associated with the VA. Risk factors for suicide risk among Veterans identified in this study include: white race (compared with non-white race), education level of >12 years (compared with <12 years), and having activity limitations. Interestingly, the number of chronic psychiatric conditions was not a significant predictor for this population (adjusted HR 0.41; 95% CI, 0.14 to 1.26).[30] This study was rated as having unclear risk of bias because of lack of information regarding missing data.

Other medical diagnoses. Severe pain: Using data on 5,082 pateints (n=854 suicides and 4,228 who did not die by suicide) from the 1999 Large Health Survey of Veterans (LHSV), VA EMRs and NDI. Ilgen et al. found that severe pain compared to moderate or less pain was associated with higher risk of death by suicide (HR 1.33; 95% CI, 1.15 to 1.54). Other predictors from multivariate models including pain were male gender, white race, smoker status, schizophrenia, bipolar disorder I or II, depression, other anxiety, diabetes, cerebrovascular disease and lower mental health functioning as measured by the Mental Component Summary (MCS).[29]

Seyfried et al. evaluated 294,952 (n=241 suicides) VA patients over age 60 with dementia drawn from national data.[35] Variables associated with suicide included: white race (OR), depression but not other psychiatric diagnoses (OR 2.0, 95% CI, 1.5 to 2.9), history of inpatient psychiatric hospitalizations (OR 2.3, 95% CI, 1.5 to 3.5), and having filled prescriptions for either antidepressants or anxiolytics (OR 2.1, 95% CI, 1.6 to 2.8 for antidepressants; OR 2.0, 95% CI, 1.5 to 2.7 for anxiolytics). In this population, admission to a nursing home was protective (OR 0.3, 95% CI, 0.1 to 0.8).

Health services factors. Hospital quality factors: Desai et al. evaluated suicide risk using data from 128 psychiatric inpatient units within US VA hospitals. They adjusted multivariate models for psychiatric diagnosis, age, race, gender, discharge to the community, distance to nearest VA medical center and year of discharge. Higher risk of suicide was predicted by shorter length of stay (<14 days, RR 1.41, p<0.04), time to readmission (>180 days, RR 0.55, p=0.0001and poor continuity of care following discharge (1 reference vs none, RR 1.59, p<0.03). Readmission within the six months following hospitalization was protective.[24]

Timing after treatment interventions: Valenstein et al. evaluated 887,859 Veterans with depression (NARDEP merged with NDI data) and found that suicide events were highest in the

first 12 weeks following psychiatric hospitalizations compared to the second 12 weeks (RR 1.9; 95% CI, 1.5 to 2.4), and higher in the 12 weeks following changes in antidepressant regimen (new antidepressant starts, adding another antidepressant, and dose changes) compared to the second 12 weeks (RR 1.8; 95% CI, 1.5 to 2.1).[38]

Retrospective case-control studies

In US Army soldiers, the adjusted odds for suicide were higher among those with a preceding hospitalization for alcohol, injury or mental disorder. Age and male gender were also associated with increased odds of suicide. Protective factors include: time in service (years), black race, less than college education, being married, and ranks as a warrant officer or commissioned officer.[20]

Among Irish Defense Forces personnel, firearm suicide was associated with psychiatric illness or a history of deliberate self-harm, performing morning duty, and a recent medical downgrading.[31]

SUMMARY OF FINDINGS

Table 1: Summary of risk factors and associations with suicide attempts and suicides

	Evidence for Suicide Attempt	***Evidence for Suicide***
Demographic factors		
Male gender		(+) Ilgen 2009[27] (+) Ilgen 2010[29] (+) Zivin 2007[41] (NS) Seyfried 2011[35]
Age	(-) Tiet 2006[37] (older age protective)	(+) Zivin 2007 (18-44 years)[41] (NS) Seyfried 2011[35]
White race		(+) Ilgen 2009 (African American race protective)[27] (+) Ilgen 2010[29] (+) Kaplan 2007[30] (+) Zivin 2007[41] (+) Seyfried 2011[35]
Marital status	(+) Thomsen 2011[36] (NS) Tiet 2006[37]	(NS) Seyfried 2011[35]
Education	(NS) Thomsen 2011[36]	(+) Kaplan 2007[30]
Smoking		(+) Ilgen 2010[29]
Psychiatric factors		
Psychiatric Conditions	(+) Ilgen 2007 (composite variable)[28] (+) Tiet 2006 (psychotic disorder, personality disorder)[37] (+) Ilgen 2010 (men and women)[25]	(+) Ilgen 2010 (personality disorder and presence of more than 1 psychiatric diagnosis)[26] (NS) Kaplan 2007 (number of chronic psychiatric conditions)[30]
PTSD	(+) Belik 2010[19] (+) Brenner 2011[21] (+) Ilgen 2010 (men and women)[25]	(+) Ilgen 2010[26] (-) PTSD was protective in Zivin 2007[41] (-) PTSD was protective in Pfeiffer 2009[32] (NS) Seyfried 2011[35]
Depression	(+) Hartl 2005[14] (+) Belik 2010[19] (+) Tiet 2006[37] (+) Ilgen 2010[25]	(+) Ilgen 2010[26] (+) Ilgen 2010[29] (NS) Pfeiffer 2009[32] (+) Seyfried 2011[35]
Bipolar Disorder	(+) Ilgen 2010 (men and women)[25] (+) Pettit 2006 (very early onset bipolar disorder)[42]	(+) Ilgen 2010[26] (+) Ilgen 2010[29]

	Evidence for Suicide Attempt	***Evidence for Suicide***
Anxiety	(+) Tiet 2006[37]	(+) Ilgen 2010(men and women)[25] (+) Ilgen 2010[26] (+) Ilgen 2010[29] (+/NS) Pfeiffer 2009 (some but not all anxiety conditions)[32] (NS) Seyfried 2011 (but having an anxiolytic prescription was associated with suicide)[35]
Schizophrenia		(+) Ilgen 2010 (men and women)[25] (+) Ilgen 2010[26] (+) Ilgen 2010[29] (NS) Seyfried 2011[35]
Prior suicide attempt	(+) Hartl 2005[14] (+) Thomsen 2011[36]	
Social phobia	(+) Belik 2010[19]	
Alcohol abuse	(+) Ilgen 2007[28] (+) Belik 2010[19] (NS) Tiet 2006[37]	(+) Ilgen 2010 (men and women)[25]
Substance abuse	(+) Ilgen 2007 (cocaine)[28] (NS) Tiet 2006[37] (drug abuse or dependence)	(+) Ilgen 2010 (men and women)[25] (+) Zivin 2007[41]
History of inpatient psychiatric hospitalization		(+) Seyfried 2011[35] (+) Zivin 2007 (within last 12 months)[41]
Negative life events	(+) Pettit 2006 (among those with very early onset MDD, very early onset anxiety and no history of very early onset psychopathology)[42]	
Trauma and military factors		
Traumatic Brain Injury (TBI)	(NS) Brenner 2011[21]	(+) Brenner 2011[22]
Witnessing man-made disaster	(+) Belik 2009 (women only)[18]	
Being a victim of child abuse or other abuse	(+) Belik 2009 (women only)[18] (+) Cox 2011 (sexual abuse and other trauma)[23]	
Witnessing domestic violence	(+) Belik 2009 (women only)[18] (+) Cox 2011 (as a child)[23]	
Being stalked	(+) Belik 2009[18]	
Being mugged, being kidnapped	(+) Belik 2009 (men only)[18]	
Having purposely injured or killed	(+) Belik 2009 (men only)[18]	
Toxic chemical exposure	(+) Belik 2009 (men only)[18]	
Life-threatening illness	(+) Belik 2009 (men only)[18]	
Sexual abuse	(+) Tiet 2006 (past 30 days or lifetime)[37] (+) Cox (childhood) (+) Belik 2009 (sexual assault or rape)[18]	
Physical abuse in past 30 days	(+) Tiet 2006 (physical abuse in past 30 days)[37] (NS) Tiet 2006 (lifetime physical abuse)[37]	
Combat deployment	(NS) Thomsen 2011[36]	
Traumatic event happened to another	(+) Belik 2009[18]	
Other trauma	(+) Belik 2009 (men only)[18]	
Being a civilian in a place where there was ongoing terror of civilians for political, ethnic, religious or other reasons)	(+) Belik 2009[18]	
Non-service connected status for Veterans		(+) Zivin 2007[41]

	Evidence for Suicide Attempt	*Evidence for Suicide*
VA association (vs non-VA associated Veterans)		(NS) Kaplan 2007 (all Veterans had higher risk of suicide regardless of VA affiliation)[30]
Other		
Diabetes		(+) Ilgen 2010[29]
Cerebrovascular disease		(+) Ilgen 2010[29]
Lower mental health functioning (MCS-12 score)		(+) Ilgen 2010[29]
Admission to nursing home		(-) protective in Seyfried 2011[35]
Severe pain		(+) Ilgen 2010[29]
Activity limitations		(+) Kaplan 2007[30]

(+) positively associated with increase in suicide outcome (i.e., risk factor)
(-) negatively associated with increase in suicide outcomes (i.e., protective factor)
(NS) evaluated and found not to be significantly associated with the suicide outcome

Table 2: Summary of Risk Studies

Author, Year	Study Design/ Analysis	Population	Outcome	Risk of Bias and main flaws
Belik 2009[18]	Cross-sectional	8,441 Canadian military personnel, active military within 6 months	Self-reported suicide attempt	Unclear
Belik 2010[19]	Cross-sectional	8,441 Canadian military personnel, active military within 6 months	Self-reported suicide attempt	Unclear
Bell 2010[20]	Case control	1,873 identified suicides from Army.	Suicide	Unclear
Brenner 2011[21] ("Posttraumatic…")	Case-control	Veterans receiving mental health services	EMR note of suicide attempt	Unclear
Brenner 2011[22] ("Suicide…")	Longitudinal	Veterans receiving mental health services	Suicide by ICD-10	Unclear
Cox 2011[23]	Cross-sectional	656 men and women admitted to the psychiatry unit of a large US Army for suicidal thoughts or behaviors	Admission for suicide attempt	Unclear
Desai 2005[24]	Longitudinal	121,933 patients discharged from US VA hospital inpatient psychiatry wards with major affective disorder, bipolar disorder, PTSD or schizophrenia (481 suicides)	Suicide identified by ICD-9/10 and NDI, 1 year after inpatient discharge	Unclear
Hartl 2005[14]	Longitudinal	630 male Veterans with PTSD	Self-reported suicide attempt after discharge from the inpatient unit	Unclear
Ilgen 2007[28]	Longitudinal	8,807 Veterans enrolled in substance abuse programs	Self-reported suicide attempt within 30 days prior to the 1 year follow-up assessment	Unclear
Ilgen 2009[27]	Longitudinal	589,825 VA patients treated for depression	Suicide confirmed by NDI	Unclear
Ilgen 2010[25] ("Psychiatric Diagnoses…")	Longitudinal	All US Veterans (3,291,891) who used VA services during Fiscal Year (FY) 1999 and were alive at the start of FY 2000	Suicide confirmed by NDI	Unclear
Ilgen 2010[29] ("Severe Pain…")	Longitudinal	260,254 US Veterans who responded to the 1999 LHSV	Suicide confirmed by NDI	Unclear
Ilgen 2010[26] ("Violent and Nonviolent Suicide…")	Longitudinal	5,082 US Veterans who were alive at the beginning of FY 2002 (854 suicides and 4,228 who did not die by suicide)	Suicide confirmed by NDI	Unclear

Author, Year	Study Design/ Analysis	Population	Outcome	Risk of Bias and main flaws
Kaplan 2007[30]	Longitudinal	104,026 male US Veterans	Suicide confirmed by NDI	Unclear
Mahon 2005[31]	Case control	732 death in Irish Defense Forces	Suicide by military files and proceedings of the Courts of Inquiry	Unclear
Pettit 2006[42]	Cross-sectional	298 military-based young adults at entry to treatment for suicidality	Self-report suicide attempt	Unclear
Pfeiffer 2009[32]	Longitudinal	887,889 US Veterans with depression	Suicides from NDI and ICD-10	Unclear
Pinder 2011[33]	Cross-sectional	821 personnel who participated in the King's Centre for Military Health Research military health study (UK Armed Forces)	Self-report of lifetime suicide attempt or self-harm	High
Roy 2011[34]	Case control	40 US Veterans with prior substance abuse, currently abstinent	Self-report suicide attempt	High
Seyfried 2011[35]	Longitudinal	294,952 US Veterans	Suicide by NDI and ICD-10	Low
Thomsen 2011[36]	Cross-sectional	2116 active duty military personnel serving at US Marine Corps installations	Self-report of suicide attempt	Unclear
Tiet 2006[37]	Cross-sectional	34,245 substance abuse patients from 150 US VA facilities	Self-report of suicide attempt in past 30 days by ASI	Unclear
Valenstein 2009[38]	Longitudinal	887,859 US Veterans with depression	Suicide using NDI	Unclear
Yerevanian 2007 - Part 2[40]	Longitudinal	405 Veterans with bipolar disorder	Suicidal behavior assessed by chart review	High
Yerevanian 2007 - Part 3[39]	Longitudinal	406 Veterans with bipolar disorder	Suicidal behavior assessed by chart review	High
Zivin 2007[41]	Longitudinal	807,694 US Veterans with depression	Suicide by NDI	Unclear

SUMMARY AND DISCUSSION

SUMMARY OF EVIDENCE BY KEY QUESTION

We identified 14 good quality systematic reviews (reported in 16 publications) of risk assessment tools and risk factors, as well as five primary studies of risk assessment tools and 25 primary studies of risk factors. Risk assessment tools and risk factor primary studies were performed in Veteran and military populations. We examined studies from a limited time period (2005 through November 2011) due to the publication of two systematic reviews with similar scope published in 2004 and 2005.[4, 5]

We conducted this report in order to gather the most up-to-date information on suicide prevention, with a particular emphasis on Veterans and members of the military. To do this, we examined systematic reviews conducted since the Gaynes and Mann reports,[4, 5] as well as primary articles focused on Veterans and members of the military. In all studies, we considered quality of design and implementation in order to best assess the strength of evidence provided. Though some studies may not be affected by certain design or implementation flaws, many studies related to suicide are complex and difficult to implement in a manner free of risk of bias. For example, studies examining suicide as an outcome may not have a significantly increased risk of bias if outcome assessors are not blinded; this is because suicide is a relatively objective outcome to assess. Suicide behavior and other aspects of suicidal self-directed violence, on the other hand, though they may appear objective, often require subjective decision-making when assessed by methods such as chart review due to variation in documentation and in definition of the outcome. Likewise, when risk factors are assessed by chart review, the same potential for bias exists if assessors are not blinded to the suicide outcome status. These quality considerations were reported with the data obtained from all included studies.

Systematic Reviews

Though we found 34 systematic reviews conducted since 2005, none of the 14 high quality reviews provided sufficient evidence for suicide risk assessment tools and suicide risk factors due to the variations in the scope of the reviews. We further examined all primary studies cited in these reviews if they met our inclusion criteria, and we included these studies in our synthesis of primary studies, listed by key question below.

Key Question #1. What assessment tools are effective for assessing risk of engaging in suicidal self-directed violence in Veteran and military populations?

Evaluation of the effectiveness of risk assessment tools is lacking, both among existing reviews with a more broad focus than this report, and among the studies examined in this report which focus on Veterans and members of the military. The three existing systematic reviews covering this topic all came to similar conclusions, noting the dearth of evidence from prospective studies examining associations among suicide prevention assessment tools and suicidal self-directed violence outcomes. Two non-systematic reviews on the topic came to similar conclusions. The Brown report cites numerous measures that have demonstrated adequate internal reliability and concurrent validity,[11] though highlights the Scale for Suicidal Ideation and the Beck Hopelessness Scale as two of only very few measures that have shown associations with death by suicide.

We examined the best available evidence from primary studies related to Veterans and members of the military. Among the five primary studies that met our inclusion criteria, three are of limited

quality. There were no studies identified that evaluated whether a risk assessment tool can accurately reclassify Veterans and military personnel from low risk of suicide to higher risk. This leads to an inconclusive rating for the overall strength of evidence regarding assessment tools for suicide. Evidence of accurate reclassification would be necessary to increase this overall assessment of strength of evidence for research investigating suicide risk assessment tools.

Though this relatively small number of studies provides insufficient and low strength evidence for the assessment of suicide risk factors with the tools that were investigated, certain aspects of the findings warrant further discussion. Two of the studies investigated assessment tools commonly used in VA settings: the PAI[13] and the BDI-II,[14] whereas the other three studies investigated tools not commonly used in VA settings[15, 16] or no longer commonly used in VA settings.[17] Of these latter three studies of assessment tools less common to VA settings, the IPS is lengthy and the results are seriously called into question due to the method of assessment and group comparison (one group was assessed by estimating history post-mortem and compared to responses from a living comparison group). The study by Hendin et al. investigated the ASQ, a brief screening tool designed to assess risk of suicide.[15] Though the sample was relatively small (n=283) and the study was rated as having an unclear risk of bias, preliminarily positive results and ease of implementation suggest that this tool warrants further research investigating potential for use and predictive power in a validation sample of Veterans or members of the military. Finally, the study by Tiet et al. investigating the ASI is useful for gathering information on a large population of Veterans.[17] Although this is only one study, the data derive from an entire population of Veterans (34,000) who were administered the ASI, lending support to the strength of evidence for this measure; however, because this lengthy structured interview is no longer routinely used in VA settings, the utility of the ASI as a suicide risk assessment tool is greatly limited.

Of the tools commonly used in the VA, the following describes considerations for implementation as suicide risk assessment tools: the PAI, though commonly used in VAs and other settings as part of lengthy psychological assessments, is difficult to administer without training, time, and electronic scoring software; however, this tool could potentially be used to design new, brief assessment measures based on the content of the subscales and items predictive of suicidal self-directed violence as preliminary evidence from this one study on a small sample of Veterans who had TBIs. Finally, the BDI-II is a brief, easy to administer, easy to score depression screening tool that is commonly used in VA settings. This tool was examined in conjunction with information on participants' previous suicide attempt history. Hartl et al. report promising exploratory model results predicting suicide attempts, though note that in a validation cohort, the model obtained a significantly lower sensitivity score.[14] Therefore, though many aspects of the research on the BDI-II are promising, further research is needed to establishing acceptable predictive power before this tool should be considered for widespread adoption. An adapted and shortened version of the PAI subscales and the BDI-II could both potentially be used in primary care settings, though given length and administration considerations, the BDI-II may be more easily implemented in such settings.

Key Question #2. In addition to the risk factors included by current assessment tools, what other risk factors predict suicidal self-directed violence in Veteran and military populations?

Studies of risk factors related to suicide indicate that psychiatric conditions are associated with suicide, especially depression and anxiety. Evidence is conflicting about whether PTSD is an independent risk factor in all or just some populations.

We identified 26 studies meeting inclusion criteria that addressed risk factors for suicidal self-directed violence in Veteran and military populations. All evaluated risk factors after accounting for variance associated with other previously established risk factors. Four of these were determined to have unacceptably high risk of bias and, therefore, are not discussed further. The remaining 22 studies were all determined to have unclear risk of bias. No studies had low risk of bias. Limitations in study design and analysis that led to a rating of high or unclear risk of bias included: assessment of suicidal behavior by chart review only, a method that is biased by provider assessment and documentation (or lack of assessment and documentation) about the behavior; lack of assessor blinding when utilizing chart review of assessment of risk factors; use of ICD-9 chart diagnoses for determination of risk (as opposed to a clinician administered tool or history); recruitment methods that reflect a non-representative population; failure to report on the handling of missing data; among others.

Suicide attempts

Nine studies of suicide attempts used longitudinal, cross-sectional and case-control analyses to assess risk factors (two not discussed further because of high risk of bias). Suicide attempt outcomes were often self-report and occasionally objectively documented (by clinician referral or hospital admission). Factors that were significant predictors of suicide attempts were: prior suicide attempt and depressive symptoms as measured by the BDI,[14] suicide or psychiatric symptoms (a composite of variables based on multiple aspects of suicidality from the ASI), alcohol and cocaine abuse.[28] Protective factors included: involvement with the criminal justice system and number of days participating in substance abuse treatment program. In a study of Canadian military personnel having purposely injured or killed, toxic chemical exposure, life-threatening illness, and being a civilian in religious terror (being a civilian in a place where there was ongoing terror of civilians for political, ethnic, religious or other reasons) were significant predictors of suicide attempts among men.[18, 19] In this study, women differed from men as to which variables predicated suicide attempt; risk factors for women tended to classified as "traumatic."

Death by suicide

Risk factors for death by suicide were assessed in 15 studies (two not discussed further because of high risk of bias; Tables 1 and 2). Outcome determination used NDI data linked with other types of registries and hospital records. Risk factors that were associated with death by suicide in more than one study include: white race, bipolar disorder and substance abuse. Several risk factors were only significant (or reported) in one study of death by suicide: education, alcohol abuse, TBI, diabetes, cerebrovascular disease, lower MCS-12 scores reflective of mental health functioning, severe pain and activity limitations. Others had mixed results, with some but not other studies finding significant association with suicide: male gender, age, anxiety, number of psychiatric conditions, PTSD, depression, anxiety, schizophrenia, history of inpatient psychiatric hospitalization, alcohol abuse and non-service connected Veteran status. Admission to a nursing home was found to be protective in one study.

Combining risk factors for suicide attempts and death by suicide may give a more thorough picture of suicide risk factors; however, doing so with the studies reviewed here does not shed substantially greater light. For PTSD, depression and psychiatric conditions, including the data from suicide attempts (in addition to the data from suicides) support these variables as risk factors for suicide. Many other risk factors remain evaluated in only one study.

LIMITATIONS

The highest quality evidence for risk assessment tools and risk factors derives from studies that evaluate tools or variables in a population and then follow that population for the development of the outcome. New risk factors must account for known risk factors so that conclusions can be drawn about whether the risk factors act independently or through other known mechanisms. Thus, studies of risk instruments have the potential to be limited by their study design (cross-sectional rather than prospective design), method of assessment of risk factors (clinician-generated diagnosis of depression versus a diagnosis of depression based on administrative codes or self-report symptom measure), and the lack of adjustment for confounding variables. For this review, we excluded many articles because they did not adjust for appropriate confounders. Careful attention to collection and adjustment for known confounders will be important for any research going forward.

We limited our search to studies on Veterans and/or members of the military. Though we chose to apply this limitation for reasons of improved generalizability given the unique risk factors experienced by the populations of interest, it is likely that important lessons could be learned from studies utilizing non-Veteran and non-military populations, and findings from such reports (e.g., the Mann, Gaynes, and NICE reports summarized in this current review)[4-6] should be considered in spite of their broader focus. Despite this restriction to Veteran and military populations, the included studies in this current report remained sufficiently heterogeneous to preclude meaningful quantitative synthesis and comparison.

Studies varied in terms of population (Veterans with mental health disorders or substance use disorders, including those with recent/current psychiatric admission versus active military), settings and risk factors assessments. Inherent to this type of research is the fact that risk factors differ between populations according to the prevalence of underlying conditions in that population. Thus, in cases where there is discrepancy about whether a certain predictive factor conveys risk, protection or is neutral (as is the case with PTSD), population differences may be part of the explanation.

Some of the factors determined by these studies are specific to the populations studied. For instance, Ilgen et al. found that number of treatment days was an important protective factor in their study of suicide after admission to inpatient substance use disorders program.[28] Clearly, this protective factor is not generalizable to populations of Veterans that have not been admitted to an inpatient treatment unit. There may be other risk factors that differ substantively between populations for other less readily apparent reasons.

Another potential limitation of this literature is the use of suicide attempts as an outcome. This outcome has high potential for misclassification bias. That is, assessment of suicide attempts relies on accurate assessment and documentation by the provider as well as accurate reporting by the patient. There is potential for under- and over-reporting in both instances. For this reason, documented suicide attempts that result in hospitalization or ER visits are more rigorous outcomes than self-reported suicide attempts.

Overall, the literature demonstrates a large group of associated risk factors that have been evaluated in various heterogeneous populations within Veteran and military groups. There have been few studies of active military personnel and women. These factors limit our ability to draw strong conclusions about risk factors that predict suicide for the entire Veteran and military population.

RECOMMENDATIONS FOR FUTURE RESEARCH

Research on suicide is inherently difficult because of the very low base rate occurrence of both suicide and suicidal self-directed violence in general populations. Therefore, future studies of both risk factors and risk assessment tools should utilize adequate sample sizes to achieve sufficient power to detect changes in rates of suicide and suicidal self-directed violence.

Future research needs to focus on critical evidence gaps. There is a striking lack of assessment tool evaluation research among Veteran and military populations. Several risk instruments have been developed and tested in other populations: the Suicide Assessment Checklist, the Manchester Self-Harm Rule, the Suicide Probability Scale, the Suicide Ideation Questionnaire, the Suicide Risk Assessment Scale, and the Beck Scale for Suicide Ideation, among others.[110-117] A reasonable next step would be to test some of these instruments in Veteran and military populations. Research would ideally be prospective and involve adequately blinded assessment techniques to reduce potential bias. Moving forward, it will also be important for studies of risk assessment tools to evaluate how well these tools discriminate people who will go on to attempt or die by suicide from those who do not.

VA medical centers and the military already use assessment tools to screen for mental health disorders associated with suicide (e.g., depression, substance use disorders, and PTSD), as well as measures designed to screen for suicidal ideation and intent. These screening tools are implemented among large, general populations of Veterans and members of the military, and are often scored and recorded in EMRs. We did not find any articles examining whether or not these measures predicted suicidal self-directed violence, though some information was available related to the Patient Health Questionnaire-9 (PHQ-9), a measure developed to screen for depression and currently broadly implemented in VA settings. One item on the PHQ-9 is designed to assess suicidality, though studies have validated this item for suicidal ideation only, as reported in follow-up clinical interviews, not suicide.[118, 119] Though this PHQ-9 item has been associated with suicidal ideation, controversy remains about whether it is an appropriate assessment tool for suicide. Critics note the vague and multi-component nature of the PHQ-9 suicidality item,[120] while proponents counter that the suicidality item should necessarily prompt further questioning that would lead to additional (adequate) assessment of suicidal ideation and plans.[120] Future research should investigate the predictive power of both the PHQ-9 and other commonly used tools implemented in VA and military primary care settings. If any such assessment tools are predictive of suicidal self-directed violence, researchers should establish cutoff scores to classify suicide risk.

Another notable gap in the literature is related to the relative paucity of research conducted with members of the military compared to studies focusing on Veterans. One reason that there are several studies using VA data is because the VA has a comprehensive clinical data source that is available for linkage with other national databases (NDI, etc.). If similar data were available for the active military population (perhaps from the military suicide event reporting database, DODSER) and/or the full complement of Veterans and military, then this could enable strong research to be completed in the military population.

An interesting question is that of coordination of care transitions and the role that the system (military, VAMC or hospital, primary care provider) plays in helping to prevent suicide. Desai

et al. suggest that improved access to care in the first six months after psychiatric hospitalization is beneficial for preventing suicide attempts.[24] Therefore, researchers might think broadly about settings in which suicide risk assessment tools are applied, such as during or immediately following inpatient hospitalization. Studies to test risk assessment tools that predict suicide attempts across multiple settings such as primary care physician visits, post-discharge (through a post-discharge follow-up phone call or visit), etc. could be valuable.

Future studies about risk factors need to address and account for known risk factors carefully. Future research should focus on determining factors that provide additional predictive power above and beyond known risk factors such as previous suicide attempt history, depression and other mental health diagnoses, and substance use disorders. Ideally, this research would be prospective, involve adequately blinded assessment techniques to reduce potential bias, and utilize adequate sample sizes to achieve sufficient power given the very low base rate occurrence of both suicide and suicidal self-directed violence. Given the unique risk factors often faced by Veterans and members of the military (e.g., combat-related PTSD, TBI, etc.), these emerging risk factors should be a particular emphasis of future research. Research in this area may also move towards an examination of warning signs, factors that are thought to signify more immediate state of risk, as opposed traditional risk factors that reflect an overall heightened state of risk. Identification of short-term warning signs could identify certain populations who need more immediate intervention.

Future research is necessary to better understand differences in risk factors among populations. In particular, the differences between risk factors for suicide among men and women are understudied. Despite the fact that the majority of suicides in the Veteran population occur in men, women have different risk factors predictive of suicide and could need different interventions in order to reduce suicide rates.

CONCLUSIONS

KQ#	Key Question	Type of Evidence	Quality of Evidence	Comments
1	What assessment tools are effective for assessing risk of engaging in suicidal self-directed violence in Veteran and military populations?	5 studies testing validated measures in Veteran or military populations	2 studies had unclear risk of bias; 3 studies had high risk of bias	Insufficient evidence overall to recommend screening with these risk assessment tools based on this evidence. Future research is warranted, particularly for risk assessment instruments that are already in use within the VA system.
2	In addition to the risk factors included by current assessment tools, what other risk factors predict suicidal self-directed violence in Veteran and military populations?	25 studies of risk factors for suicide attempts and suicides among Veteran and military populations	21 studies with unclear risk of bias and 4 studies with high risk of bias	Insufficient evidence overall. Strongest evidence exists for risk factors that have been previously identified (white race, male gender, psychiatric disorders, substance use disorders, and trauma). More research is warranted to understand emerging risk factors in younger Veteran and military populations.

REFERENCES

1. Kochanek KD, Xu J, Murphy SL, Miniño AM, Kung H-C. Deaths: preliminary data for 2009. *Natl Vital Stat Rep.* 2011;59(4):1-51.

2. Reger MA, Luxton DD, Skopp NA, Lee JA, Gahm GA, Suicide Risk Management & Surveillance Office (SRMSO). *Department of Defense Suicide Event Report (DoDSER): Calendar Year 2008 Annual Report* 2008.

3. Kang HK, Bullman TA. Risk of suicide among US veterans after returning from the Iraq or Afghanistan war zones. *JAMA: Journal of the American Medical Association.* 2008 Aug;300(6):652-3.

4. Mann JJ, Apter A, Bertolote J, et al. Suicide prevention strategies: a systematic review. *JAMA.* 2005 Oct 26;294(16):2064-74.

5. Gaynes BN, West SL, Ford CA, et al. Screening for Suicide Risk in Adults: A Summary of the Evidence for the U.S. Preventive Services Task Force. *Annals of Internal Medicine May.* 2004;140(10):822-35.

6. National Institute for Health and Clinical Excellence. Self-harm: longer-term management in adults, children and young people [Draft for Consultation]. *National Collaborating Centre for Mental Health,.* 2011.

7. Shekelle P, Bagley S, Munjas B. Strategies for Suicide Prevention in Veterans. *Evidence-based Synthesis Program.* 2009 Jan.

8. Oxman AD, Guyatt GH. Validation of an index of the quality of review articles. *Journal of Clinical Epidemiology.* 1991;44(11):1271-8.

9. Harris RP, Helfand M, Woolf SH, et al. Current methods of the US Preventive Services Task Force: a review of the process. *Am J Prev Med.* 2001;20(3 Suppl):21-35.

10. Hayden JA, Cote P, Bombardier C. Evaluation of the Quality of Prognosis Studies in Systematic Reviews. *Annals of Internal Medicine March.* 2006;144(6):427-37.

11. Brown GK. A Review of Suicide Assessment Measures for Intervention Research with Adults and Older Adults. *Bethesda, MD: National Institute of Mental Health.* 2002; http://www.hawaii.edu/hivandaids/Review%20of%20Suicide%20Assess%20for%20Interven%20Res%20w%20Adults%20and%20Older%20Adults.pdf. Accessed February 12.

12. Goldston DB. *Assessment of suicidal behaviors and risk among children and adolescents* 2000.

13. Breshears RE, Brenner LA, Harwood JE, Gutierrez PM. Predicting suicidal behavior in veterans with traumatic brain injury: the utility of the personality assessment inventory. *J Pers Assess.* 2010 Jul;92(4):349-55.

14. Hartl TL, Rosen C, Drescher K, Lee TT, Gusman F. Predicting high-risk behaviors in veterans with posttraumatic stress disorder. *J Nerv Ment Dis.* 2005 Jul;193(7):464-72.

15. Hendin H, Al Jurdi RK, Houck PR, Hughes S, Turner J. Role of intense affects in predicting short-term risk for suicidal behavior: A prospective study. *Journal of Nervous and Mental Disease.* 2010 Mar;198(3):220-5.

16. Nademin E, Jobes DA, Pflanz SE, et al. An investigation of interpersonal-psychological variables in air force suicides: a controlled-comparison study. *Arch Suicide Res.* 2008;12(4):309-26.

17. Tiet QQ, Ilgen MA, Byrnes HF, Moos RH. Suicide attempts among substance use disorder patients: an initial step toward a decision tree for suicide management. *Alcohol Clin Exp Res.* 2006 Jun;30(6):998-1005.

18. Belik SL, Stein MB, Asmundson GJ, Sareen J. Relation between traumatic events and suicide attempts in Canadian military personnel. *Can J Psychiatry.* 2009 Feb;54(2):93-104.

19. Belik SL, Stein MB, Asmundson GJ, Sareen J. Are Canadian soldiers more likely to have suicidal ideation and suicide attempts than Canadian civilians? *Am J Epidemiol.* 2010 Dec 1;172(11):1250-8.

20. Bell NS, Harford TC, Amoroso PJ, Hollander IE, Kay AB. Prior health care utilization patterns and suicide among U.S. Army soldiers. *Suicide Life Threat Behav.* 2010 Aug;40(4):407-15.

21. Brenner LA, Betthauser LM, Homaifar BY, et al. Posttraumatic Stress Disorder, Traumatic Brain Injury, and Suicide Attempt History among Veterans Receiving Mental Health Services. *Suicide Life Threat Behav.* 2011 May 20.

22. Brenner LA, Ignacio RV, Blow FC. Suicide and traumatic brain injury among individuals seeking Veterans Health Administration services. *J Head Trauma Rehabil.* 2011 Jul-Aug;26(4):257-64.

23. Cox DW, Ghahramanlou-Holloway M, Szeto EH, et al. Gender differences on documented trauma histories: inpatients admitted to a military psychiatric unit for suicide-related thoughts or behaviors. *J Nerv Ment Dis.* 2011 Mar;199(3):183-90.

24. Desai RA, Dausey DJ, Rosenheck RA. Mental Health Service Delivery and Suicide Risk: The Role of Individual Patient and Facility Factors. *The American Journal of Psychiatry.* 2005 Feb;162(2):311-8.

25. Ilgen MA, Bohnert AS, Ignacio RV, et al. Psychiatric diagnoses and risk of suicide in veterans. *Arch Gen Psychiatry.* 2010 Nov;67(11):1152-8.

26. Ilgen MA, Conner KR, Valenstein M, Austin K, Blow FC. Violent and nonviolent suicide in veterans with substance-use disorders. [erratum apperas in J Stud Alcohol Drugs 71 (5): 795]. *J Stud Alcohol Drugs.* 2010 Jul;71(4):473-9.

27. Ilgen MA, Downing K, Zivin K, et al. Exploratory data mining analysis identifying subgroups of patients with depression who are at high risk for suicide. *J Clin Psychiatry.* 2009 Nov;70(11):1495-500.

28. Ilgen MA, Harris AH, Moos RH, Tiet QQ. Predictors of a suicide attempt one year after entry into substance use disorder treatment. *Alcohol Clin Exp Res.* 2007 Apr;31(4):635-42.

29. Ilgen MA, Zivin K, Austin KL, et al. Severe pain predicts greater likelihood of subsequent suicide. *Suicide Life Threat Behav.* 2010 Dec;40(6):597-608.

30. Kaplan MS, Huguet N, McFarland BH, Newsom JT. Suicide among male veterans: a prospective population-based study. *J Epidemiol Community Health.* 2007 Jul;61(7):619-24.

31. Mahon MJ, Tobin JP, Cusack DA, Kelleher C, Malone KM. Suicide among regular-duty military personnel: a retrospective case-control study of occupation-specific risk factors for workplace suicide. *Am J Psychiatry.* 2005 Sep;162(9):1688-96.

32. Pfeiffer PN, Ganoczy D, Ilgen M, Zivin K, Valenstein M. Comorbid anxiety as a suicide risk factor among depressed veterans. *Depress Anxiety.* 2009;26(8):752-7.

33. Pinder RJ, Iversen AC, Kapur N, Wessely S, Fear NT. Self-harm and attempted suicide among UK Armed Forces personnel: Results of a cross-sectional survey. *Int J Soc Psychiatry.* 2011 Jun 21.

34. Roy A, Carli V, Sarchiapone M. Resilience mitigates the suicide risk associated with childhood trauma. *J Affect Disord.* 2011 May 27.

35. Seyfried LS, Kales HC, Ignacio RV, Conwell Y, Valenstein M. Predictors of suicide in patients with dementia. *Alzheimers Dement.* 2011 Nov;7(6):567-73.

36. Thomsen CJ, Stander VA, McWhorter SK, Rabenhorst MM, Milner JS. Effects of combat deployment on risky and self-destructive behavior among active duty military personnel. *J Psychiatr Res.* 2011 May 4.

37. Tiet QQ, Finney JW, Moos RH. Recent sexual abuse, physical abuse, and suicide attempts among male veterans seeking psychiatric treatment. *Psychiatr Serv.* 2006 Jan;57(1):107-13.

38. Valenstein M, Kim HM, Ganoczy D, et al. Higher-risk periods for suicide among VA patients receiving depression treatment: prioritizing suicide prevention efforts. *J Affect Disord.* 2009 Jan;112(1-3):50-8.

39. Yerevanian BI, Koek RJ, Mintz J. Bipolar pharmacotherapy and suicidal behavior Part 3: impact of antipsychotics. *J Affect Disord.* 2007 Nov;103(1-3):23-8.

40. Yerevanian BI, Koek RJ, Mintz J, Akiskal HS. Bipolar pharmacotherapy and suicidal behavior Part 2. The impact of antidepressants. *J Affect Disord.* 2007 Nov;103(1-3):13-21.

41. Zivin K, Kim HM, McCarthy JF, et al. Suicide mortality among individuals receiving treatment for depression in the Veterans Affairs health system: associations with patient and treatment setting characteristics. *Am J Public Health.* 2007 Dec;97(12):2193-8.

42. Pettit JW, Paukert AL, Joiner TE, Jr., Rudd MD. Pilot sample of very early onset bipolar disorder in a military population moderates the association of negative life events and non-fatal suicide attempt. *Bipolar Disord.* 2006 Oct;8(5 Pt 1):475-84.

43. Centers for Disease Control and Prevention (CDC). Suicide facts at a glance. *National Center for Injury Prevention and Control.* 2009; Available at http://www.cdc.gov/violenceprevention/pdf/Suicide-DataSheet-a.pdf. Accessed 1/3/2012.

44. Goldsmith SK, Pelmar TC, Kleinman AM, Bunny WE, eds. *Reducing suicide: A national imperative*. Washington (DC): National Academy Press; 2002.

45. Nock MK, Borges G, Bromet EJ, Cha CB, Kessler RC, Lee S. Suicide and suicidal behavior. *Epidemiol Rev.* 2008;30:133-54.

46. Centers for Disease Control and Prevention, National Center for Injury Prevention and Control. National Violent Death Reporting System: Monitoring and Tracking the Causes of Violent Deaths - 2008. 2008; http://www.cdph.ca.gov/programs/Documents/nvdrs_aag_2008-a.pdf. Accessed February 29, 2012.

47. McCarthy JF, Valenstein M, Kim HM, Ilgen M, Zivin K, Blow FC. Suicide mortality among patients receiving care in the veterans health administration health system. *American journal of epidemiology.* 2009 Apr 15;169(8):1033-8.

48. Blow FC, Bohnert ASB, Ilgen MA, et al. Suicide Mortality Among Patients Treated by the Veterans Health Administration From 2000 to 2007. *American Journal of Public Health.* 2012;102(S1):S98-S104.

49. Kuehn BM. Soldier suicide rates continue to rise: military, scientists work to stem the tide. *JAMA.* 2009 Mar 18;301(11):1111-3.

50. Department of Veterans Affairs. Screening and evaluation of possible traumatic brain injury in operation enduring freedom (OEF) and operation Iraqi freedom (OIF) veterans. *VHA Directive 2007-013.* 2007.

51. Department of Veterans Affairs. Report of the Blue Ribbon Work Group on Suicide Prevention in the Veteran Population. 2008; Available at http://www.mentalhealth.va.gov/suicide_prevention/Blue_Ribbon_Report-FINAL_June-30-08.pdf. Accessed January 3, 2012.

52. US Public Health Service. *The Surgeon General's Call to Action to Prevent Suicide*. Washington, D.C.1999.

53. World Health Organization. SUPRE Prevention of suicidal behaviors: a task for all. 2007; Available at http://www.who.int/mental_health/prevention/suicide/information/en/index.html. Accessed January 3, 2012.

54. Luoma J, Martin C, Pearson J. Contact with mental health and primary care providers before suicide: A review of the evidence. *American Journal of Psychiatry.* 2002;159(6):909-16.

55. Basham C, Denneson LM, Millet L, Shen X, Duckart J, Dobscha SK. Characteristics and VA Health Care Utilization of U. S. Veterans Who Completed Suicide in Oregon Between 2000 and 2005. *Suicide Life Threat Behav.* 2011 Apr 4;42(3):287-96.

56. Schulberg HC, Bruce ML, Lee PW, Williams JWJ, Dietrich AJ. Preventing suicide in primary care patients: the primary care physician's role. *Gen Hosp Psychiatry.* 2004;26(5):337-45.

57. Bajaj P, Borreani E, Ghosh P, Methuen C, Patel M, Crawford MJ. Screening for suicidal thoughts in primary care: the views of patients and general practitioners. *Ment Health Fam Med.* 2008;5(4):229-35.

58. Lambert MT. Seven-year outcomes of patients evaluated for suicidality. *Psychiatr Serv.* 2002;53(1):92-4.

59. Lambert MT, Fowler DR. Suicide risk factors among veterans: risk management in the changing culture of the Department of Veterans Affairs. *J Ment Health Adm.* 1997;24(3):350-8.

60. Martin J, Ghahramanlou-Holloway M, Lou K, Tucciarone P. A comparative review of U.S. Military and civilian suicide behavior: Implications for OEF/OIF suicide prevention efforts. *Journal of Mental Health and Counseling* 2009;31(2):101-18.

61. Cavanagh J, Carson A, Sharpe M, SM L. Psychological autopsy studies of suicide: A systematic review. *Psychological Medicine.* 2003;33:395-405.

62. Zamorski MA. Suicide prevention in military organizations. *Int Rev Psychiatry.* 2011 Apr;23(2):173-80.

63. Teasdale T, Engberg A. Suicide after traumatic brain injury: a population study. *Journal of Neurology, Neurosurgery & Psychiatry.* 2001;71(4):436-40.

64. Joiner T. *Why people die by suicide*. Cambridge: Harvard University Press; 2005.

65. Brenner LA, Gutierrez PM, Cornette MM, Betthauser LM, Bahraini N, Staves PJ. A Qualitative study of potential suicide risk factors in returning combat veterans. *Journal of Mental Health Counseling.* 2008 Jul;30(3):211-25.

66. Brenner LA, Breshears RE, Betthauser LM, et al. Implementation of a Suicide Nomenclature within Two VA Healthcare Settings. *J Clin Psychol Med Settings.* 2011 Jun;18(2):116-28.

67. Centers for Disease Control and Prevention, Crosby AE, Han B, et al. Suicidal thoughts and behaviors among adults aged ≥18 years --- United States, 2008-2009. *MMWR Surveill Summ.* 2011 Oct 21;60(13):1-22.

68. Kutcher S, Szumilas M. Controlling for known risk factors for suicide in multivariate models. *Can J Psychiatry.* 2010 Apr;55(4):269; author reply 70.

69. Owens DK, Lohr KN, Atkins D, et al. AHRQ series paper 5: grading the strength of a body of evidence when comparing medical interventions--agency for healthcare research and quality and the effective health-care program. *J Clin Epidemiol.* 2010 May;63(5):513-23.

70. Moher D, Liberati A, Tetzlaff J, Altman DG, The Prisma Group. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. *PLoS Med.* 2009;6(7):e1000097.

71. Bhui K, McKenzie K, Rasul F. Rates, risk factors & methods of self harm among minority ethnic groups in the UK: a systematic review. *BMC Public Health.* 2007;7:336.

72. Borschmann R, Hogg J, Phillips R, Moran P. Measuring self-harm in adults: A systematic review. *Eur Psychiatry.* 2011 Jun 20.

73. Bowers L, Banda T, Nijman H. Suicide inside: a systematic review of inpatient suicides. *J Nerv Ment Dis.* 2010 May;198(5):315-28.

74. Bridge JA, Iyengar S, Salary CB, et al. Clinical response and risk for reported suicidal ideation and suicide attempts in pediatric antidepressant treatment: a meta-analysis of randomized controlled trials. *JAMA.* 2007 Apr 18;297(15):1683-96.

75. Burrows S, Laflamme L. Socioeconomic disparities and attempted suicide: state of knowledge and implications for research and prevention. *Int J Inj Contr Saf Promot.* 2010 Mar;17(1):23-40.

76. Calabria B, Degenhardt L, Hall W, Lynskey M. Does cannabis use increase the risk of death? Systematic review of epidemiological evidence on adverse effects of cannabis use. *Drug Alcohol Rev.* 2010 May;29(3):318-30.

77. Calati R, Porcelli S, Giegling I, et al. Catechol-o-methyltransferase gene modulation on suicidal behavior and personality traits: Review, meta-analysis and association study. *Journal of Psychiatric Research.* 2011 Mar;45(3):309-21.

78. Carpenter DJ, Fong R, Kraus JE, Davies JT, Moore C, Thase ME. Meta-analysis of efficacy and treatment-emergent suicidality in adults by psychiatric indication and age subgroup following initiation of paroxetine therapy: a complete set of randomized placebo-controlled trials. *J Clin Psychiatry.* 2011 Feb 22.

79. Chen LP, Murad MH, Paras ML, et al. Sexual abuse and lifetime diagnosis of psychiatric disorders: systematic review and meta-analysis. *Mayo Clin Proc.* 2010 Jul;85(7):618-29.

80. Goldman-Mellor SJ, Saxton KB, Catalano RC. Economic contraction and mental health: A review of the evidence, 1990-2009. *International Journal of Mental Health.* 2010 Sum;39(2):6-31.

81. Hammerness PG, Vivas FM, Geller DA. Selective serotonin reuptake inhibitors in pediatric psychopharmacology: a review of the evidence. *J Pediatr.* 2006 Feb;148(2):158-65.

82. Haw C, Hawton K, Sutton L, Sinclair J, Deeks J. Schizophrenia and Deliberate Self-Harm: A Systematic Review of Risk Factors. *Suicide and Life Threatening Behavior.* 2005 Feb;35(1):50-62.

83. Hawton K, Sutton L, Haw C, Sinclair J, Harriss L. Suicide and attempted suicide in bipolar disorder: a systematic review of risk factors. *J Clin Psychiatry.* 2005 Jun;66(6):693-704.

84. Hor K, Taylor M. Suicide and schizophrenia: a systematic review of rates and risk factors. *J Psychopharmacol.* 2010 Nov;24(4 Suppl):81-90.

85. Innamorati M, Pompili M, Amore M, et al. Suicide prevention in late life: Is there sound evidence for practice? In: Pompili M, Tatarelli R, eds. *Evidence-based practice in suicidology: A source book*. Cambridge, MA: Hogrefe Publishing; 2011:211-32.

86. Kallert TW, Glockner M, Schutzwohl M. Involuntary vs. voluntary hospital admission. A systematic literature review on outcome diversity. *Eur Arch Psychiatry Clin Neurosci.* 2008 Jun;258(4):195-209.

87. Kim YS, Leventhal B. Bullying and suicide. A review. *Int J Adolesc Med Health.* 2008 Apr-Jun;20(2):133-54.

88. King M, Semlyen J, Tai SS, et al. A systematic review of mental disorder, suicide, and deliberate self harm in lesbian, gay and bisexual people. *BMC Psychiatry.* 2008;8:70.

89. Large M, Smith G, Sharma S, Nielssen O, Singh SP. Systematic review and meta-analysis of the clinical factors associated with the suicide of psychiatric in-patients. *Acta Psychiatr Scand.* 2011 Jul;124(1):18-29.

90. Lemon DD. Killing me softly: A meta-analysis examining risk factors associated with suicide among young African American males. *Dissertation Abstracts International: Section B: The Sciences and Engineering.* 2009;69(10-B):6420.

91. Maniglio R. The role of child sexual abuse in the etiology of suicide and non-suicidal self-injury. *Acta Psychiatr Scand.* 2011 Jul;124(1):30-41.

92. McMillan D, Gilbody S, Beresford E, Neilly L. Can we predict suicide and non-fatal self-harm with the Beck Hopelessness Scale? A meta-analysis. *Psychol Med.* 2007 Jun;37(6):769-78.

93. Mironova P, Rhodes AE, Bethell JM, et al. Childhood physical abuse and suicide-related behavior: A systematic review. *Vulnerable Children and Youth Studies.* 2011 Mar;6(1):1-7.

94. O'Connor EA, Whitlock EP, Beil TL, Gaynes BN. Screening for depression in adult patients in primary care settings: a systematic evidence review. *Ann Intern Med.* 2009 Dec 1;151(11):793-803.

95. O'Connor EA, Whitlock EP, Gaynes B, Beil TL. Screening for Depression in Adults and Older Adults in Primary Care: An Updated Systematic Review. 2009 Dec Systematic Review.

96. Perry AE, Marandos R, Coulton S, Johnson M. Screening tools assessing risk of suicide and self-harm in adult offenders: a systematic review. *Int J Offender Ther Comp Criminol.* 2010 Oct;54(5):803-28.

97. Platt B, Hawton K, Simkin S, Mellanby RJ. Systematic review of the prevalence of suicide in veterinary surgeons. *Occup Med (Lond).* 2010 Sep;60(6):436-46.

98. Rhodes AE, Boyle MH, Tonmyr L, et al. Sex differences in childhood sexual abuse and suicide-related behaviors. *Suicide Life Threat Behav.* 2011 Jun;41(3):235-54.

99. Rowell K, Green B, Guidry J, Eddy J. Factors associated with suicide among African American adult men: A systematic review of the literature. *Journal of Men's Health.* 2008 Dec;5(4):274-81.

100. Sakinofsky I. Treating suicidality in depressive illness. Part 2: does treatment cure or cause suicidality? *Can J Psychiatry.* 2007 Jun;52(6 Suppl 1):85S-101S.

101. Sakinofsky I. Treating suicidality in depressive illness. Part 1: current controversies. *Can J Psychiatry.* 2007 Jun;52(6 Suppl 1):71S-84S.

102. Sakinofsky I. The current evidence base for the clinical care of suicidal patients: strengths and weaknesses. *Can J Psychiatry.* 2007 Jun;52(6 Suppl 1):7S-20S.

103. Spiegel B, Schoenfeld P, Naliboff B. Systematic review: the prevalence of suicidal behaviour in patients with chronic abdominal pain and irritable bowel syndrome. *Aliment Pharmacol Ther.* 2007 Jul 15;26(2):183-93.

104. State of Victoria Department of Health. Suicide risk assessment and management: A systematic evidence review for the Clinical practice guidelines for emergency departments and mental health services project. *Mental Health, Drugs and Regions Division.* 2010.

105. Van Lieshout RJ, MacQueen GM. Efficacy and acceptability of mood stabilisers in the treatment of acute bipolar depression: systematic review. *Br J Psychiatry.* 2010 Apr;196:266-73.

106. Weich S, Patterson J, Shaw R, Stewart-Brown S. Family relationships in childhood and common psychiatric disorders in later life: systematic review of prospective studies. *Br J Psychiatry.* 2009 May;194(5):392-8.

107. Williams SB, O'Connor E, Eder M, Whitlock E. Screening for Child and Adolescent Depression In Primary Care Settings: A Systematic Evidence Review for the U.S. Preventive Services Task Force. 2009 Apr.

108. Williams SB, O'Connor EA, Eder M, Whitlock EP. Screening for child and adolescent depression in primary care settings: a systematic evidence review for the US Preventive Services Task Force. *Pediatrics.* 2009 Apr;123(4):e716-35.

109. McLellan AT, Kushner H, Metzger D, et al. The Fifth Edition of the Addiction Severity Index. *Journal of Substance Abuse Treatment.* 1992;9(3):199-213.

110. Huth-Bocks AC, Kerr DC, Ivey AZ, Kramer AC, King CA. Assessment of psychiatrically hospitalized suicidal adolescents: self-report instruments as predictors of suicidal thoughts and behavior. *J Am Acad Child Adolesc Psychiatry.* 2007 Mar;46(3):387-95.

111. Harriss L, Hawton K. Suicidal intent in deliberate self-harm and the risk of suicide: The predictive power of the Suicide Intent Scale. *Journal of Affective Disorders.* 2005 Jun;86(2-3):225-33.

112. Harriss L, Hawton K, Zahl D. Value of measuring suicidal intent in the assessment of people attending hospital following self-poisoning or self-injury. *British Journal of Psychiatry.* 2005 Jan;186(1):60-6.

113. Gutierrez PM, Osman A. Getting the best return on your screening investment: An analysis of the Suicidal Ideation Questionnaire and Reynolds Adolescent Depression Scale. *School Psychology Review.* 2009;38(2):200-17.

114. Naud H, Daigle MS. Predictive validity of the Suicide Probability Scale in a male inmate population. *Journal of Psychopathology and Behavioral Assessment.* 2010 Sep;32(3):333-42.

115. Cooper J, Kapur N, Dunning J, Guthrie E, Appleby L, Mackway-Jones K. A clinical tool for assessing risk after self-harm. *Ann Emerg Med.* 2006 Oct;48(4):459-66.

116. Daigle MS, Labelle R, Cote G. Further evidence of the validity of the Suicide Risk Assessment Scale for prisoners. *Int J Law Psychiatry.* 2006 Sep-Oct;29(5):343-54.

117. Healy DJ, Barry K, Blow F, Welsh D, Milner KK. Routine use of the Beck Scale for Suicide Ideation in a psychiatric emergency department. *Gen Hosp Psychiatry.* 2006 Jul-Aug;28(4):323-9.

118. Walker J, Hansen CH, Hodges L, et al. Screening for suicidality in cancer patients using Item 9 of the nine-item patient health questionnaire; does the item score predict who requires further assessment? *Gen Hosp Psychiatry.* 2010 Mar-Apr;32(2):218-20.

119. Walker J, Hansen CH, Butcher I, et al. Thoughts of death and suicide reported by cancer patients who endorsed the "suicidal thoughts" item of the PHQ-9 during routine screening for depression. *Psychosomatics.* 2011 Sep-Oct;52(5):424-7.

120. Thompson R, Henkel V, Coyne JC, Goodwin RD, Kroenke K. Letter to the Editor (with response): Suicidal ideation in primary care: Ask a vague question, get a confusing answer. *Psychosomatic Medicine.* 2004;66(455-7).