



# Suicide Risk Factors and Risk Assessment Tools: A Systematic Review

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## **PREFACE**

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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.

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

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## **EXECUTIVE SUMMARY**

### **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, and suicide among military and Veteran populations is of particular concern.<sup>1</sup> 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.<sup>2,3</sup> Several aspects of military experience may increase the risk of suicide, including mental health and substance abuse. Many risk factors specific to the OEF/OIF population have yet to be thoroughly evaluated and incorporated into clinical management.

Ideally, suicide risk assessment tools need to account for the relationship among 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, such tools will be brief enough to be conducted in a primary care setting and will identify a threshold beyond which preventive action should be taken. Risk assessment tools should be able to discriminate those at high- and low-risk for suicidal self-directed violence. Likewise, studies of emerging risk factors need to evaluate the contribution of a new potential predictor of suicide and self-directed violence in the context of known risk factors in order to weigh the contribution of the new risk factor against those that are currently known.

The objective of this report is to review recent evidence about risk factors and risk assessment tools within Veteran and military populations to provide evidence for clinical practice guideline development specific to these populations.

The key questions addressed in this report were:

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?

### **METHODS**

The Veterans Affairs (VA)/Department of Defense (DoD) suicide prevention Evidence Based Practice Working Group (EBPWG) requested a systematic review of literature related to suicidal self-directed violence published since two prior reports on the topic by Mann et al. and Gaynes et al.;<sup>4,5</sup> therefore, we used the end search date from the Mann et al. review as the starting point for the current search. The workgroup requested a review focused on specific countries and populations of interest because of their similarity to US Veteran and military populations, and requested a report highlighting risk factors and assessment tools most relevant to US Veteran and military populations. Due to the timeline and large body of literature identified that is focused on Veteran and military populations, as well as the existence of the recent National Institute for

Health and Clinical Excellence (NICE) 2011 review on self-harm in all populations including civilians,<sup>6</sup> we limited the scope of this review to articles focused on Veteran and military populations, highlighting relevant reviews on civilian populations in each section of the report. Though a previous systematic review focused on Veterans and members of the military was conducted by Shekelle et al. in 2009,<sup>7</sup> the EBPWG requested that the current review focus on risk factors and assessment tools, which were largely excluded from that report.

We identified relevant systematic reviews and relevant primary studies by searching PubMed, PsycINFO, the Cochrane Database of Systematic Reviews<sup>®</sup>, and the Cochrane Central Register of Controlled Trials<sup>®</sup> from 2005 to November 18, 2011. We used suicide and related terminology, and included risk assessment, screening and validity, military, Veterans 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 a previously published systematic review on the topic.<sup>4,5</sup> Additional citations were identified from reference lists, consultation with content experts, and web sources. Doctoral level investigators and project research associates trained in the critical analysis of literature reviewed all titles, abstracts and full-text articles; full-text articles were reviewed in duplicate. Data abstraction and quality assessment (risk of bias determination) of all included primary studies and systematic reviews were performed in duplicate by investigators and research associates. We assessed study quality of systematic reviews using Oxman and Guyatt criteria.<sup>8</sup> We assessed the risk of bias of primary studies of assessment tools and primary studies of risk factors using modified versions of the tools described by Harris 2001 and Hayden 2006.<sup>9,10</sup>

## **DATA SYNTHESIS**

We constructed evidence tables showing the study characteristics and results for all included studies, organized by key question and study design. We critically analyzed studies to compare their characteristics, methods, and findings. We compiled a summary of findings for each key question, and drew conclusions based on qualitative synthesis of the findings.

We also report findings as described in the prior systematic reviews by Mann et al., Gaynes et al., and the NICE 2011 draft report on self-harm<sup>4-6</sup> in order to assess contributions of pre-2005 and non-Veteran, non-military literature to this report. 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.

## **PEER REVIEW**

A draft version of this report was reviewed by seven technical experts, as well as clinical leadership. Reviewer comments were addressed and our responses were incorporated in the final report (Appendix M).

## **RESULTS**

We reviewed 16,521 titles and abstracts from the electronic and hand searches. After applying our inclusion/exclusion criteria (see Study Selection Form, Appendix B), we rejected 15,743 at

the abstract level, and performed a more detailed full-text review on 778 articles. From these, we identified 30 observational studies and 14 systematic reviews (reported in 16 publications) that addressed at least one of the key questions.

### **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*

To address the body of literature that evaluated suicide assessment tools and risk prior to 2005 and in non-Veteran and non-military populations, we highlight findings from systematic reviews of suicide by Mann et al. and Gaynes et al., and one on repetition of self-harm by NICE in 2011;<sup>4-6</sup> as well as two non-systematic literature reviews highlighting existing suicide assessment tools for adults and older adults by Brown, and for children and adolescents by Goldston.<sup>11, 12</sup> Together, the Brown and Goldston papers describe the psychometric properties and cite validation studies for over 60 measures designed to assess suicidal ideation and behavior. The Brown report cites numerous measures that have demonstrated adequate internal reliability and concurrent validity, and highlights the Scale for Suicidal Ideation and the Beck Hopelessness Scale as two of 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 need further research. Goldston specifically highlights the need for prospective studies examining the association between these assessment tools and death by suicide.

The three systematic reviews on suicide and self-harm, Mann et al., Gaynes et al. and NICE 2011,<sup>4-6</sup> also emphasize the need for further prospective research to establish the effectiveness of these assessment tools in predicting suicidal self-directed violence. All three report 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 most recent and comprehensive review on the topic published by NICE describes findings from six cohort studies examining prediction of death by suicide in patients with prior non-fatal self-harm.<sup>6</sup> These authors report that, overall, the findings were indicative of high rates of false positive identification of individuals as being at risk for suicide. The authors also note that the short follow-up times of the studies combined with the inadequate sample sizes needed to detect effects on such a low base-rate outcome, among other limitations, preclude the ability to recommend the use of these suicide risk assessment tools in clinical practice. This report also investigated scales designed to predict repeated self-harm, and described similar limitations among these scales. 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 for identification of those at risk for suicidal self-directed violence in civilian populations.

#### *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. Five articles<sup>13-17</sup> met our inclusion criteria and described assessment tools used within military or

Veteran populations. The risk assessment tools used in these studies include: the Addiction Severity Index (ASI), a lengthy structured clinical interview designed to be used as an intake interview for a substance abuse treatment program;<sup>17</sup> the Personality Assessment Inventory (PAI), a lengthy assessment tool designed to be administered by a psychologist in the context of an in-depth psychological assessment;<sup>13</sup> the Interpersonal Psychological Survey (IPS), a 34-item measure;<sup>16</sup> the Beck Depression Inventory-II (BDI), a 21-item, commonly used depression screening tool that includes a question about suicidal ideation;<sup>14</sup> and a brief screening tool, the Affective States Questionnaire (ASQ).<sup>15</sup> None of these studies were rated as having a low risk of bias. Two of these were rated as having an unclear risk of bias,<sup>15, 17</sup> and three had methodological flaws resulting in a high risk of bias (Appendix J).<sup>13, 14, 16</sup> None of these performed reclassification analysis, which is the current gold standard for the evaluation of risk assessment tools. The two higher quality are discussed below;<sup>15, 17</sup> three other studies with high risk of bias (due to unclear selection criteria for the study population, unclear/unstandardized risk factor assessment, and lack of systematic outcome assessment, including lack of assessor blinding and retrospective estimation of scores for those who died by suicide) are described in more detail within the full report.<sup>13, 14, 16</sup>

Tiet et al. investigated the use of the ASI using data from over 34,000 Veterans who were assessed as part of substance abuse treatment at 150 Veterans Affairs Medical Centers (VAMCs) nationwide.<sup>17</sup> Sensitivity ranged from 0.33-0.89 and specificity ranged from 0.42-0.87. Despite its rating as having an unclear risk of bias, this study provides moderate strength evidence for the risk assessment capabilities of the ASI based on its large sample size (i.e., the entire population of Veterans who completed a structured and electronically documented substance abuse intake process). However, given the range of sensitivity and specificity data, it is unlikely that a cut-off with adequate sensitivity would have an acceptably low rate of false positives.<sup>17</sup> This assessment tool is not ideal for settings that require brief screening tools, though it was previously widely used and available in many Veterans' medical charts.

Hendin et al. examined a brief screening tool, the ASQ, as a predictor of suicidal behavior.<sup>15</sup> This study was conducted among a population of 283 Veterans receiving inpatient or outpatient services at a VAMC. Using a cutoff of  $\geq 3$ , the ASQ resulted in sensitivity of 0.60 and specificity of 0.74 in this population. This study is limited in its applicability and received a rating of unclear risk of bias because of insufficient information on patient selection and assessor blinding to the suicidal behavior outcome. Because of this and its relatively small sample size, this 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.

Overall, evaluation of the effectiveness of risk assessment tools is lacking. It is unclear whether a risk assessment tool can accurately reclassify Veterans and military personnel from low risk to higher risk. Conclusive evidence of reclassification in studies with low risk of bias would be necessary to increase this overall assessment of strength of evidence for research investigating suicide risk assessment tools.

**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 of risk factors in non-Veteran and non-military populations*

To review the contributions of literature prior to 2005 and in civilian populations, we highlight findings from existing systematic reviews of risk factors in any population. These include two systematic reviews of suicide by Mann et al., Gaynes et al., and one on repetition of self-harm by NICE in 2011.<sup>4-6</sup> 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 not adjusted for important confounders (other risk factors that might explain the association, e.g. mental health diagnoses).

The NICE report found that the following factors predicted non-fatal repetition of self-harm in adults:<sup>6</sup> 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.<sup>6</sup>

### *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).<sup>14, 18-42</sup> Tables 1 and 2 in the main body of this report list all risk factors identified and the studies that contributed to evidence for that risk factor (Table 1), and the study design, population, outcome and risk of bias for each study (Table 2).

The populations represented in these studies are US Veterans in 17 studies, active duty US military personnel in three studies and other military populations in six studies. Outcomes include death by suicide in 13 studies, self-reported suicide attempts in 11 studies, suicidal behavior assessed by chart review or clinician referral, or admission for suicide attempt.

Risk of bias for the 26 identified studies is included in Appendix L. Four studies had a high risk of bias, and therefore will not be discussed further in this report.<sup>33, 34, 39, 40</sup> The remaining 22 studies were rated as having unclear risk of bias. Limitations of the studies evaluated here that accounted for low 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 International Classification of Diseases (ICD) 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.

### *Suicide attempts*

Nine studies of suicide attempts used longitudinal, cross-sectional and case-control analyses to assess risk factors. (2 studies not discussed further because they had 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,<sup>14</sup> suicide or psychiatric symptoms (a composite of variables based on multiple aspects of suicidality from the ASI), alcohol and cocaine abuse.<sup>28</sup> 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 having lived as a civilian in a place where there was ongoing terror of civilians for political, ethnic, religious or other reasons (“religious terror”) were significant predictors of suicide attempts among men.<sup>18, 19</sup> In this study, women differed from men as to which variables predicated suicide attempt; risk factors for women tended to be classified as “traumatic”.

### *Death by suicide*

Death by suicide was assessed in 17 studies. Outcome determination was most commonly performed using National Death Index (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 (Table 1). Several risk factors were only significant (or reported) in one study of death by suicide: education, alcohol abuse, traumatic brain injury (TBI), diabetes, cerebrovascular disease, lower Mental Component Summary (MCS) 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, post-traumatic stress disorder (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 on which risk factors are most predictive. Using data from both suicide and suicide attempts, PTSD and depression, and psychiatric conditions appear to have adequate evidence to support their acceptance as a risk factor for suicide. Many other risk factors remain evaluated in only one study, thereby limiting conclusions about their utility for predicting suicide.

Limitations of these studies include heterogeneous populations, settings and risk factors assessments. Specifically, risk factors may differ between populations with different underlying conditions. In cases where there is discrepancy about whether a factor conveys risk, protection

or is neutral (as is the case with PTSD), population differences may be part of the explanation. In addition to using different populations, studies do not assess the same risk factors. This limits the ability to either quantitatively or qualitatively compare across studies. This fact also limits the ability to adequately assess a new risk factor. For example, when a study of a new risk factor fails to include or adequately report on the contribution of another known risk factor, one cannot be certain that the new risk factor is independent in its prediction of the outcome.

Some of the factors determined by these studies are specific to the populations studied. For instance, Ilgen et al. 2007 found that number of treatment days was an important protective factor in their study of suicide after admission to inpatient substance use disorders program.<sup>28</sup> 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.

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.

# 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.<sup>1</sup> Suicide was the tenth leading cause of death in the US in 2009.<sup>1</sup> The rate is highest among 25 to 34 year-olds, for whom suicide is the second leading cause of death.<sup>43</sup> For each suicide death, there are approximately 25 suicide attempts, also referred to as incidents of suicidal self-directed violence.<sup>44,45</sup> The lifetime risk of suicidal self-directed violence for the general US population is estimated to be between 1.9 and 8.7 percent.<sup>45</sup>

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,<sup>46</sup> and the rate of suicides among Veterans utilizing Veterans Health Administration (VHA) services is estimated to be higher than the general population.<sup>47,48</sup> 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.<sup>49</sup> 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.<sup>2,3</sup> The enormity of the problem has led to several major public health initiatives and growing interest in suicide and self-directed violence prevention.<sup>50-53</sup>

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.<sup>54</sup> 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.<sup>55</sup>

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.<sup>56,57</sup> 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.<sup>56,58-60</sup> 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.<sup>61</sup>

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.<sup>62</sup> Other risk factors unique to the military experience could also contribute to overall suicide risk, including military rank, combat exposure, traumatic brain injury (TBI),<sup>22,63</sup> habituation to violence,<sup>64</sup> and deployment-related stressors (e.g., strained or

long distance relationships, relocation, post-deployment adjustment).<sup>60, 65</sup>

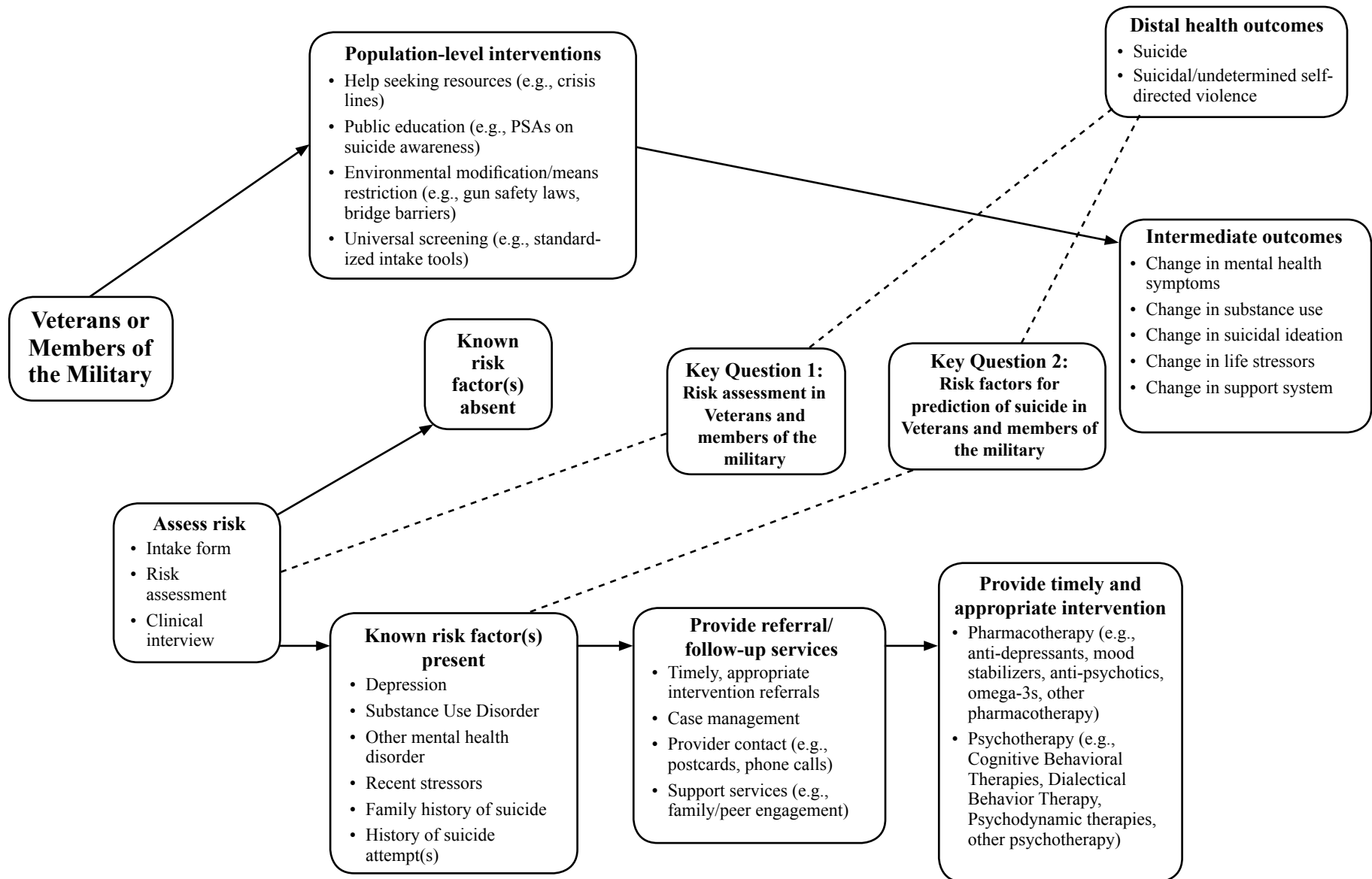
Of course, many military and Veteran personnel will have one or more of these individual risk factors, but relatively few of them are truly at-risk for suicidal self-directed violence. Suicide risk assessment tools need to account for the relationship among these different risk factors and identify risk 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),<sup>5</sup> 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.<sup>5</sup> 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.”<sup>66, 67</sup> 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.

Figure 1. Suicide Prevention Analytical Model



## **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.<sup>66, 67</sup> published since two prior reports on the topic by Mann et al. and Gaynes et al.<sup>4, 5</sup> 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.<sup>6</sup> 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<sup>®</sup>, and the Cochrane Central Register of Controlled Trials<sup>®</sup>. We used a similar search strategy as Mann et al.,<sup>4</sup> 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.<sup>4, 5</sup> 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.<sup>68</sup> 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,<sup>4,6</sup> 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.<sup>8</sup> 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.<sup>9, 10</sup> 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.<sup>69</sup> 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.<sup>4,5</sup> 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,<sup>6</sup> 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.<sup>4,5</sup> We also summarize the information on repeated self-harm (including suicide) reported in the NICE 2011 review.<sup>6</sup> 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**

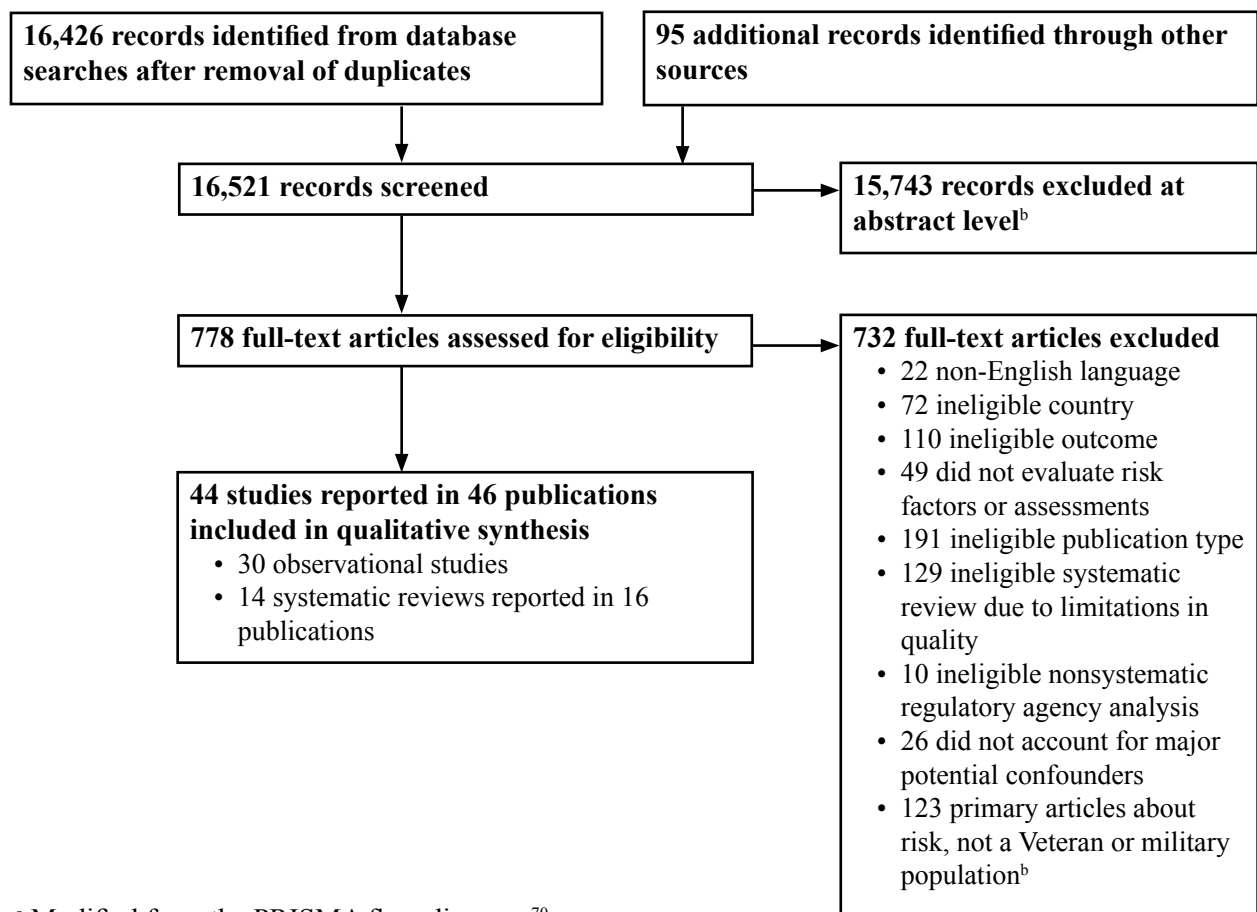
A draft version of this report was reviewed by seven technical experts as well as clinical leadership. Their comments and our responses are presented in Appendix M.

## 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<sup>a</sup>**



<sup>a</sup> Modified from the PRISMA flow diagram.<sup>70</sup>

<sup>b</sup> 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.<sup>71-108</sup> Using the Oxman and Guyatt criteria, we assessed these reviews for risk of bias (Appendix F).<sup>8</sup> Fourteen reviews had minimal flaws (a rating of 6 or 7); these are summarized in Appendix G.<sup>74, 76, 79, 83, 86, 88, 89, 91, 94-97, 104, 105, 107, 108</sup> 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;<sup>4-6</sup> 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.<sup>11, 12</sup>

Brown and Goldston<sup>11, 12</sup> 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,<sup>11, 12</sup> 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,<sup>4-6</sup> 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<sup>13-17</sup> 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,<sup>13, 14, 16</sup> and two of which were rated as having unclear risk of bias (Appendix J).<sup>15, 17</sup>

Hendin et al. examined a brief screening tool, the Affective States Questionnaire (ASQ), as a predictor of suicidal behavior.<sup>15</sup> 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  $\geq 3$ , 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.<sup>17</sup> 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.<sup>13</sup> 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).<sup>16</sup> 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 in 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.<sup>14</sup> 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.<sup>4-6</sup> 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:<sup>6</sup> 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.<sup>6</sup>

### **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).<sup>14, 18-42</sup> 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.<sup>33, 34, 39, 40</sup> 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.<sup>14, 28</sup> 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).<sup>14</sup> No data are provided about how various levels of BDI scores predict suicide attempts.

Ilgen et al. reported on how the ASI<sup>109</sup> administered within two weeks of entry into a VA addiction treatment program predicted suicide one year later.<sup>28</sup> 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.<sup>28</sup> 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.<sup>18, 19, 36, 37, 42</sup> Two of these used active duty military Canadian military personnel.<sup>18, 19</sup> 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.<sup>18</sup> In the second study, Belik et al. 2010 found that depressive episodes, social phobia, alcohol dependence, generalized anxiety disorder and PTSD were associated with increased odds of suicide attempt.<sup>19</sup>

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.<sup>37</sup> 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.<sup>37</sup>

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.<sup>36</sup> 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.<sup>36</sup>

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.<sup>42</sup> 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.<sup>42</sup>

### *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.<sup>21</sup> 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.<sup>21</sup> 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.<sup>23</sup> 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.<sup>23</sup> 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.<sup>22, 24-27, 29, 30, 32, 35, 38, 41</sup> 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.<sup>25</sup> 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.<sup>26</sup> 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.<sup>27</sup> 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.<sup>32</sup> 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  $\geq$  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.<sup>41</sup> 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 2001 and 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.<sup>22</sup> 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 to the Multiple Cause of Death file through 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).<sup>30</sup> 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 patients (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).<sup>29</sup>

Seyfried et al. evaluated 294,952 (n=241 suicides) VA patients over age 60 with dementia drawn from national data.<sup>35</sup> 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=0.0001) and 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.<sup>24</sup>

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).<sup>38</sup>

*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.<sup>20</sup>

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.<sup>31</sup>

**SUMMARY OF FINDINGS**

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

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

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

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

(+) 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**

<b>Author, Year</b>	<b>Study Design/ Analysis</b>	<b>Population</b>	<b>Outcome</b>	<b>Risk of Bias and main flaws</b>
Belik 2009 <sup>18</sup>	Cross-sectional	8,441 Canadian military personnel, active military within 6 months	Self-reported suicide attempt	Unclear
Belik 2010 <sup>19</sup>	Cross-sectional	8,441 Canadian military personnel, active military within 6 months	Self-reported suicide attempt	Unclear
Bell 2010 <sup>20</sup>	Case control	1,873 identified suicides from Army.	Suicide	Unclear
Brenner 2011 <sup>21</sup> ("Posttraumatic...")	Case-control	Veterans receiving mental health services	EMR note of suicide attempt	Unclear
Brenner 2011 <sup>22</sup> ("Suicide...")	Longitudinal	Veterans receiving mental health services	Suicide by ICD-10	Unclear
Cox 2011 <sup>23</sup>	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 <sup>24</sup>	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 <sup>14</sup>	Longitudinal	630 male Veterans with PTSD	Self-reported suicide attempt after discharge from the inpatient unit	Unclear
Ilgen 2007 <sup>28</sup>	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 <sup>27</sup>	Longitudinal	589,825 VA patients treated for depression	Suicide confirmed by NDI	Unclear
Ilgen 2010 <sup>25</sup> ("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 <sup>29</sup> ("Severe Pain...")	Longitudinal	260,254 US Veterans who responded to the 1999 LHSV	Suicide confirmed by NDI	Unclear
Ilgen 2010 <sup>26</sup> ("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



<b>Author, Year</b>	<b>Study Design/ Analysis</b>	<b>Population</b>	<b>Outcome</b>	<b>Risk of Bias and main flaws</b>
Kaplan 2007 <sup>30</sup>	Longitudinal	104,026 male US Veterans	Suicide confirmed by NDI	Unclear
Mahon 2005 <sup>31</sup>	Case control	732 death in Irish Defense Forces	Suicide by military files and proceedings of the Courts of Inquiry	Unclear
Pettit 2006 <sup>42</sup>	Cross-sectional	298 military-based young adults at entry to treatment for suicidality	Self-report suicide attempt	Unclear
Pfeiffer 2009 <sup>32</sup>	Longitudinal	887,889 US Veterans with depression	Suicides from NDI and ICD-10	Unclear
Pinder 2011 <sup>33</sup>	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 <sup>34</sup>	Case control	40 US Veterans with prior substance abuse, currently abstinent	Self-report suicide attempt	High
Seyfried 2011 <sup>35</sup>	Longitudinal	294,952 US Veterans	Suicide by NDI and ICD-10	Low
Thomsen 2011 <sup>36</sup>	Cross-sectional	2116 active duty military personnel serving at US Marine Corps installations	Self-report of suicide attempt	Unclear
Tiet 2006 <sup>37</sup>	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 <sup>38</sup>	Longitudinal	887,859 US Veterans with depression	Suicide using NDI	Unclear
Yerevanian 2007 - Part 2 <sup>40</sup>	Longitudinal	405 Veterans with bipolar disorder	Suicidal behavior assessed by chart review	High
Yerevanian 2007 - Part 3 <sup>39</sup>	Longitudinal	406 Veterans with bipolar disorder	Suicidal behavior assessed by chart review	High
Zivin 2007 <sup>41</sup>	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.<sup>4,5</sup>

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,<sup>4,5</sup> 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,<sup>11</sup> 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<sup>13</sup> and the BDI-II,<sup>14</sup> whereas the other three studies investigated tools not commonly used in VA settings<sup>15, 16</sup> or no longer commonly used in VA settings.<sup>17</sup> 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.<sup>15</sup> 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.<sup>17</sup> 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.<sup>14</sup> 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,<sup>14</sup> suicide or psychiatric symptoms (a composite of variables based on multiple aspects of suicidality from the ASI), alcohol and cocaine abuse.<sup>28</sup> 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.<sup>18, 19</sup> In this study, women differed from men as to which variables predicated suicide attempt; risk factors for women tended to be 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)<sup>4-6</sup> 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.<sup>28</sup> 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.<sup>110-117</sup> 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.<sup>118, 119</sup> 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,<sup>120</sup> while proponents counter that the suicidality item should necessarily prompt further questioning that would lead to additional (adequate) assessment of suicidal ideation and plans.<sup>120</sup> 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.<sup>24</sup> 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.

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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).

## APPENDIX A. SEARCH STRATEGIES

OVID MEDLINE searched from 2005 – November 18, 2011	
Suicide	“Suicide”[Mesh] OR “Suicide, Attempted”[Mesh] OR suicid*
Risk	“Risk”[Mesh] OR “Risk Assessment”[Mesh] OR “Risk Factors”[Mesh] OR risk[Title/Abstract]
Screening	“mass screening”[Mesh] OR “Validation studies”[Publication Type] OR Screening[title] OR screen[title] OR assessment[title] OR assessments[title] OR questionnaire[title] OR questionnaires[title] OR instrument[title] OR instruments[title] OR tool[title] OR tools[title] OR scale[title] OR scales[title] OR measure[title] OR measures[title]
Prevention	Prevent* OR depression OR health education OR health promotion OR public opinion OR mass screening OR family physicians OR medical Education OR primary healthcare OR antidepressive agents OR psychotherapy OR schools OR adolescents OR methods OR firearms OR overdose OR poisoning OR gas poisoning OR mass media
Suicide Prevention	(“Suicide/prevention and control”[Mesh] OR Suicide, Attempted/prevention and contril”[Mesh]) NOT (case report* OR editorial* OR letter)
Suicide Prevention OR (Suicide AND (Risk OR Screening OR Prevention))	

PsycINFO, Cochrane and HAPI Search November 18, 2011

Limited from 2005 – November 18, 2011

Search Strategy:

- 
- 1 exp Attempted Suicide/ or exp Suicide Prevention/
  - 2 (prevent\* or depression or health education or health promotion or public opinion or mass screening or family physicians or medical education or primary health care or antidepressive agents or psychotherapy or schools or adolescents or methods or firearms or overdose or poisoning or gas poisoning or mass media).mp. [mp=title, abstract, heading word, table of contents, key concepts, original title, tests & measures]
  - 3 suicide.mp. [mp=title, abstract, heading word, table of contents, key concepts, original title, tests & measures]
  - 4 2 and 3
  - 5 1 or 4
  - 6 exp Case Report/
  - 7 editorial.mp.

- 8 letter.mp.
- 9 6 or 7 or 8
- 10 5 not 9
- 11 exp Attempted Suicide/ or exp Suicide/ or suicide.mp.
- 12 (suicide or suicidal or suicides or suicidality).mp. [mp=title, abstract, heading word, table of contents, key concepts, original title, tests & measures]
- 13 11 or 12
- 14 exp Risk Assessment/ or risk.mp. or exp Risk Factors/
- 15 exp Screening/
- 16 exp test validity/
- 17 screening.m\_titl.
- 18 screen.m\_titl.
- 19 assessment.m\_titl.
- 20 assessments.m\_titl.
- 21 questionnaire.m\_titl.
- 22 questionnaires.m\_titl.
- 23 instrument.m\_titl.
- 24 instruments.m\_titl.
- 25 tool.m\_titl.
- 26 tools.m\_titl.
- 27 scales.m\_titl.
- 28 measure.m\_titl.
- 29 measures.m\_titl.
- 30 risk.mp.
- 31 14 or 15 or 16 or 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24 or 25 or 26 or 27 or 28 or 29 or 30
- 32 13 and 31
- 33 10 or 32

## APPENDIX B. STUDY SELECTION FORM

### VA ESP Suicide Prevention Study Selection Process: Coding

#### Step 1: Importing citations

- Enter database name, search date, and other details into Custom 1.

#### Step 2: Title/Abstract level coding

- The objective of the title/abstract review phase is to eliminate obviously irrelevant publications. Abstracts that lack an explicit reference to suicidal self-directed violence (e.g., suicidality, behaviors, attempts, and suicides) will be excluded at this phase. Reviewers will provide decision and characteristic codes and these will be recorded in Custom 3 of the EndNote library.
  - Decision codes:
    - **R**=Retrieve
    - **E**=Exclude
    - **B**=Retrieve for Background
  - Characteristic codes: Our first priority is retrieval of systematic reviews, especially those focusing on Veteran or military populations. Our second priority is retrieval of primary studies in Veteran or military populations. For ease of identifying these subsets of publications in the ENL, reviewers should add either or both of the following codes when applicable:
    - **SR**=systematic review
    - **V**=Veteran or military population

#### Step 3: Full-text level coding

- Record final decision to include study in review, and any other study characteristics of interest
  - **Characteristics of interest (recorded in Custom Fields):**
    - Population: Veteran and/or military, or non-Veteran or non-military
    - Risk Article Type: Risk factors, or risk assessment
    - Study Design: Systematic Review, clinical trial (randomized or nonrandomized), observational study, or other
  - **Full-text exclusion codes to be entered into Custom 4:**
    - 1=Non-English language
    - 2=Ineligible country (only including US, UK, Canada, New Zealand, Australia)
    - 3=Ineligible outcome
    - 4=Study does not evaluate risk factors or assessments
    - 5=Ineligible publication type (e.g., letter, editorial, publication available only as abstract, non-systematic review, etc.)
    - 6=Ineligible systematic review due to limitations in quality
    - 7=Nonsystematic regulatory agency analysis
    - 8=Risk factor articles that did not account for major potential confounders
    - 9=Primary articles about risk, not a Veteran or military population
- Full-text coding to be completed in the format of a label affixed to each publication in the format shown below. Reviewer 1 will circle relevant characteristics and inclusion decision and list an exclusion code when applicable. Reviewer 2 will verify Reviewer 1's decisions and circle Agree or Disagree. All disagreements will be resolved using a consensus process and consensus decisions recorded.
- Label:
  - Pop: Vet-Mil / Non-Vet-Mil
  - Risk: Risk / Assess / NA
  - Design: SR / CT / Obs / Other
  - Rev1: Include / Exclude – Code: \_\_\_\_\_
  - Rev2: Agree / Disagree Consensus: \_\_\_\_\_

## APPENDIX C. CRITERIA USED IN QUALITY ASSESSMENT OF SYSTEMATIC REVIEWS

Criteria	Operationalization of Criteria <sup>a</sup>
<p><b>1. Were the search methods reported?</b>  <i>Were the search methods used to find evidence (original research) on the primary questions stated?</i>                      “Yes” if the review states the databases used, date of most recent searches, and some mention of search terms.</p>	<p>The purpose of this index is to evaluate the scientific quality (i.e., adherence to scientific principles) of research overviews (review articles) published in the medical literature. It is not intended to measure literary quality, importance, relevance, originality, or other attributes of overviews.</p> <p>The index is for assessing overviews of primary (“original”) research on pragmatic questions regarding causation, diagnosis, prognosis, therapy, or prevention. A research overview is a survey of research. The same principles that apply to epidemiological surveys apply to overviews: a question must be clearly specified, a target population identified and accessed; appropriate information obtained from that population in an unbiased fashion; and conclusions derived, sometimes with the help of formal statistical analysis, as is done in “meta-analyses”. The fundamental difference between overviews and epidemiological studies is the unit of analysis, not the scientific issues that the questions in this index address.</p> <p>Since most published overviews do not include a methods section, it is difficult to answer some of the questions in the index. Base your answers, as much as possible, on information provided in the overview. If the methods that were used are reported incompletely relative to a specific question, score it as “can’t tell,” unless there is information in the overview to suggest either the criterion was or was not met.</p>
<p><b>2. Was the search comprehensive?</b>  <i>Was the search for evidence reasonably comprehensive?</i>                      “Yes” if the review searches at least 2 databases and looks at other sources (such as reference lists, hand searches, and queries experts).</p>	
<p><b>3. Were the inclusion criteria reported?</b>  <i>Were the criteria used for deciding which studies to include in the overview reported?</i></p>	
<p><b>4. Was selection bias avoided?</b>  <i>Was bias in the selection of studies avoided?</i>                      “Yes” if the review reports how many studies were identified by searches, numbers excluded, and gives appropriate reasons for excluding them (usually because of pre-defined inclusion/exclusion criteria).</p>	
<p><b>5. Were the validity criteria reported?</b>  <i>Were the criteria used for assessing the validity of the included studies reported?</i></p>	
<p><b>6. Was validity assessed appropriately?</b>  <i>Was the validity of all the studies referred to in the text assessed using appropriate criteria (either in selecting studies for inclusion or in analyzing the studies that are cited)?</i>                      “Yes” if the review reports validity assessment and did some type of analysis with it (e.g., sensitivity analysis of results according to quality ratings, excluded low-quality studies, etc.)</p>	

Criteria	Operationalization of Criteria <sup>a</sup>		
<p><b>7. Were the methods used to combine studies reported?</b>  <i>Were the methods used to combine the findings of the relevant studies (to reach a conclusion) reported?</i>                      “Yes” for studies that did qualitative analysis if there is some mention that quantitative analysis was not possible and reasons that it could not be done, or if ‘best evidence’ or some other grading of evidence scheme used.</p>	<p>For Question 8, if no attempt has been made to combine findings, and no statement is made regarding the inappropriateness of combining findings, check “No” if a summary (general) estimate is given anywhere in the abstract, the discussion, or the summary section of the paper; and if it is not reported how that estimate was derived, mark “No” even if there is a statement regarding the limitations of combining the findings of the studies reviewed. If in doubt, mark “Can’t tell”.</p> <p>For an overview to be scored as “Yes” in Question 9, data (not just citations) must be reported that support the main conclusions regarding the primary question(s) that the overview addresses.</p> <p>The score for Question 10, the overall scientific quality, should be based on your answers to the first nine questions. The following guidelines can be used to assist with deriving a summary score: If the “Can’t tell” option is used one or more times on the preceding questions, a review is likely to have minor flaws at best and it is difficult to rule out major flaws (i.e., a score of 4 or lower). If the “No” option is used on Question 2, 4, 6 or 8, the review is likely to have major flaws (i.e., a score of 3 or less, depending on the number and degree of the flaws).</p>		
<p><b>8. Were the findings combined appropriately?</b>  <i>Were the findings of the relevant studies combined appropriately relative to the primary question the overview addresses?</i>                      “Yes” if the review performs a test for heterogeneity before pooling, does appropriate subgroup testing, appropriate sensitivity analysis, or other such analysis.</p>			
<p><b>9. Were the conclusions supported by the reported data?</b>  <i>Were the conclusions made by the author(s) supported by the data and/or analysis reported in the overview?</i></p>			
<p><b>10. What was the overall scientific quality of the overview?</b>  <i>How would you rate the scientific quality of this overview?</i></p>			
<p><i>Scoring</i> <span style="float: right;"><b>Each Question is scored as Yes, Partially/Unclear or No</b></span></p>			
<p><b>Extensive Flaws</b> 1</p>	<p><b>Major Flaws</b> 2</p>	<p><b>Minor Flaws</b> 3</p>	<p><b>Minimal Flaws</b> 4</p>
<p>1</p>	<p>2</p>	<p>3</p>	<p>4</p>

<sup>a</sup> Table created using information from Oxman & Guyatt, J Clin Epidemiol. 1991;44(11):1271-8 and Furlan, Clarke, et al., Spine. 2001 Apr 1;26(7):E155-62.

## APPENDIX D. CRITERIA USED IN QUALITY ASSESSMENT OF PRIMARY STUDIES RELATED TO ASSESSING RISK OF ENGAGING IN SUICIDAL SELF-DIRECTED VIOLENCE<sup>a</sup>

Domain	Description
1. Adequate description of population	Study describes inclusion criteria for selecting patients, demographics (at least age), and setting (primary care vs. hospital vs. other).
2. Non-biased selection	Study either reports enrolling (or attempting to enroll) a consecutive series of patients meeting inclusion criteria, or a random sample.
3. Low loss to follow-up/missing data?	Was there important differential loss to follow-up or overall high loss to follow-up? Numbers should be given for each group.
4a. Standardized method of risk factor assessment and scoring clearly described or referenced.	Standardized, reproducible methods of assessment and scoring must be reported or referenced.
4b. Unbiased risk factor assessment by independent assessors?	Study describes unbiased risk factor assessment by independent assessors.
5a. Adequate outcome measurement?	Study clearly describes standardized and reproducible methods to identify/define the events - suicide attempt or behavior - in the entire population of eligible participants regardless of initial risk assessment.
5b. Unbiased outcome measurement by independent assessors?	Study clearly describes unbiased methods to identify/define the events - suicide attempt or behavior - by independent assessors.
6. Adequate accounting for potential confounders?	Potential confounders are accounted for by a comparable control group or statistical methods of adjustment.

<sup>a</sup> Modified from Hayden et al. 2006 and Harris et al. 2001.<sup>9,10</sup>

## APPENDIX E. CRITERIA USED IN QUALITY ASSESSMENT OF PRIMARY STUDIES RELATED TO ADDITIONAL RISK FACTORS TO PREDICT SUICIDAL SELF-DIRECTED VIOLENCE<sup>a</sup>

Domain	Description
1. Adequate description of population	Study describes inclusion criteria for selecting patients, demographics (at least age), and setting (primary care vs. hospital vs. other).
2. Non-biased selection	Study either reports enrolling (or attempting to enroll) a consecutive series of patients meeting inclusion criteria, or a random sample (was any group of patients systematically excluded?)
3. Low loss to follow-up/missing data adequately described? (Yes/Partly/No/Unsure)	Was there low overall missing data and no differences between comparison groups in missing data? Was there an adequate description of the handling of missing data? Numbers should be given for each group.
4. Adequate/unbiased risk factor measurement? (Yes/Partly/No/Unsure)	Study describes reproducible and appropriate methods for measuring prognostic factors. Note the inadequate factors as applicable (e.g., depression without description of measurement method or use of inferior method such as self-report).
5. Adequate/unbiased outcome measurement? (Yes/Partly/No/Unsure)	Study clearly describes reproducible and appropriate methods to identify/define the events - suicide attempt or behavior. Were methods objective or self-report?
6. Was the sample size adequate (including adequate number of outcome events)? (Yes/No/Unsure)	Study has adequate participant numbers to assess differences in suicide rates based on risk factors. Studies of higher risk populations (psychiatric disorders, prior suicide attempts) may need fewer people to have adequate sample size.
7. Adequate statistical adjustment	Study performs statistical adjustment or controls for one or more potential confounders using acceptable statistical methods (must include 1 of the following: suicidal ideation, any mental health diagnosis, prior suicide attempt, substance abuse).
8. Number of required confounders adjusted for in analysis	Count of the confounders reported in #7 (total possible = 4).
9. External validity	Is the population relevant to the population of interest? Describe.

<sup>a</sup> Modified from Hayden et al. 2006 and Harris et al. 2001.<sup>9, 10</sup>



## APPENDIX F. QUALITY RATING OF SYSTEMATIC REVIEWS USING OXMAN AND GUYATT<sup>8</sup> CRITERIA

Author, Year of systematic review	Search methods reported	Comprehensive search	Inclusion criteria reported	Selection bias avoided	Validity criteria reported	Validity assessed appropriately	Methods used to combine studies reported	Findings combined appropriately	Conclusions supported by data	Overall scientific quality (range 1-7; higher score is better)
Bhui 2007 <sup>71</sup>	Yes - no search dates (lists only publication dates)	Yes	Yes	Unclear - study design not addressed; study comparing rates among ethnic groups	Yes - used 5 criteria from their own previously published work; dual review	Yes	Unclear - no exclusions made on the basis of quality	No - only two studies included in meta-analysis	Yes	5
Borschmann 2011 <sup>72</sup>	Yes	Yes	Yes	Yes	No	No	NA	NA - no pooling	Yes	3
Bowers 2010 <sup>73</sup>	Partially - no end date for search	Yes	No	No	No	No	Unclear	Unclear	No quantitative conclusions	2
Bridge 2007 <sup>74</sup>	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	7
Burrows 2010 <sup>75</sup>	Partially - dates not reported	Yes	Yes	No - numbers of studies identified, screened, and excluded not reported	No	No	NA - no pooling	NA - no pooling	Yes	3
Calabria 2010 <sup>76</sup>	Yes	Yes	Yes	Excluded reviews, case series, and irrelevant studies	Yes	McGrath and Saha method, Delphi method	Unclear if any studies were excluded because of poor quality but all included studies scored $\geq 6$	Only 2 studies included in meta-analysis with suicide as outcome	Yes	6
Calati 2011 <sup>77</sup>	Partially - end date only	Yes	Yes	No report of total number identified	Yes	Yes	Unclear if any excluded because of quality	Yes	Yes	5
Carpenter 2011 <sup>78</sup>	No	No	No	No	No	No	Yes	Yes	Unclear	1
Chen 2010 <sup>79</sup>	Yes	Partially - no hand searching or reference lists	Yes	Yes	Yes	Yes	Yes	Yes	Yes	6
Goldman-Mellor 2010 <sup>80</sup>	Yes	Yes	Yes	Yes	Yes	Unclear	Unclear - not used in analyses	Unclear - no meta-analysis	Unclear	4
Hammerness 2006 <sup>81</sup>	Yes	Yes	Yes	Yes	No	No	NA	NA - no pooling	Yes	3
Haw 2005 <sup>82</sup>	Yes	Yes	Yes	2 independent reviewers for abstracts but no report of decisions	No	Unclear	Yes	Unclear	Yes	5

Author, Year of systematic review	Search methods reported	Comprehensive search	Inclusion criteria reported	Selection bias avoided	Validity criteria reported	Validity assessed appropriately	Methods used to combine studies reported	Findings combined appropriately	Conclusions supported by data	Overall scientific quality (range 1-7; higher score is better)
Hawton 2005 <sup>83</sup>	Yes	Yes	Yes	Yes	Yes - but design only	No	Yes	Yes	Yes	6
Hor 2010 <sup>84</sup>	Yes	Partially - no hand searching	Yes	Yes	Yes	Yes	Yes	No - did not do meta-analysis	Unclear	5
Innamorati 2011 <sup>85</sup>	Yes	Partially - no hand searching	Yes - but vague	Unclear	No	No	No - narrative summary	Unclear	Unclear	1
Kallert 2008 <sup>86</sup>	Yes	Yes	Yes	Yes	Yes	Partially - reports details of validity assessment, but no analysis based on findings	NA	NA - no pooling	Yes	6
Kim 2008 <sup>87</sup>	Partially - dates not reported	No - databases only	Yes	No - only reports number of articles reviewed at full-text level	No	NA	NA	NA - no pooling	Yes	3
King 2008 <sup>88</sup>	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	7
Large 2011 <sup>89</sup>	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	7
Lemon 2009 <sup>90</sup>	Partially	Yes	Yes	No - only reports number of articles reviewed at full-text level	No	No	Yes	Yes	Yes	4
Maniglio 2011 <sup>91</sup>	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	7
McMillan 2007 <sup>92</sup>	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	3
Mironova 2011 <sup>93</sup>	Yes	Yes	Yes	Yes	No - "Formal quality assessment rules were not applied, given the lack of consensus and evaluation tools to assess observational studies."	No	NA	NA - no pooling	Yes	3
O'Connor 2009 <sup>95</sup> & O'Connor 2009 <sup>94</sup>	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	7
Perry 2010 <sup>96</sup>	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	7
Platt 2010 <sup>97</sup>	Yes	Yes	Yes	Yes	Yes	Yes	No - no mention	NA - no pooling	Yes	6
Rhodes 2011 <sup>98</sup>	Yes	Yes	Yes	Yes	No (same as Mironova 2011) <sup>93</sup>	No	NA	NA - no pooling	Yes	3
Rowell 2008 <sup>99</sup>	Yes	Yes	Yes	Yes	Yes	No - design only	No	No	No	2

Author, Year of systematic review	Search methods reported	Comprehensive search	Inclusion criteria reported	Selection bias avoided	Validity criteria reported	Validity assessed appropriately	Methods used to combine studies reported	Findings combined appropriately	Conclusions supported by data	Overall scientific quality (range 1-7; higher score is better)
Sakinofsky 2007 <sup>101</sup> & Sakinofsky 2007 <sup>100</sup> & Sakinofsky 2007 <sup>102</sup>	Yes	Yes	No	Unclear	Yes	Yes - but weak criteria	NA	NA	Unclear	3
Spiegel 2007 <sup>103</sup>	Yes	Yes	Yes	Yes	No	No	No	No	Yes	3
State of Victoria Department of Health 2010 <sup>104</sup>	Yes	Yes	Yes	Yes	Yes	Yes	No - no mention	Yes	Yes	6
Van Lieshout 2010 <sup>105</sup>	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	7
Weich 2009 <sup>106</sup>	Yes	No - databases only	Yes	Yes	Yes	Yes	Yes	Yes	Yes	5
Williams 2009 <sup>107</sup> & Williams 2009 <sup>108</sup>	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	7

## APPENDIX G. DATA ABSTRACTION FOR PRIMARY STUDIES OBTAINED FROM GOOD QUALITY SYSTEMATIC REVIEWS<sup>a</sup>

Author, Year of systematic review	Objective of systematic review	Time period and databases searched in systematic review	Potentially eligible studies for the current risk report	Excluded studies for the current risk report	Eligibility criteria in systematic review
Bridge 2007 <sup>74</sup>	To assess the efficacy and risk of reported suicidal ideation/suicide attempt of antidepressants for treatment of pediatric MDD, OCD, and non-OCD anxiety disorders	PubMed (1988 to July 2006), Relevant US and British regulatory agency reports, Published abstracts of important scientific meetings (1998-2006), Clinical trial registries	<ul style="list-style-type: none"> <li>- Berard 2006</li> <li>- Emslie 2006</li> <li>- Emslie 2007</li> <li>- March 2007</li> <li>- Rynn 2007</li> </ul> <p><b>All non-Veteran, non-military populations</b></p>	<p><b>Studies before 2005:</b></p> <ul style="list-style-type: none"> <li>- Birmaher 2003</li> <li>- Emslie 1997</li> <li>- Emslie 2002</li> <li>- Geller 2001</li> <li>- Geller 2004</li> <li>- Keller 2001</li> <li>- Liebowitz 2002</li> <li>- March 1998</li> <li>- March 2004</li> <li>- POTS Study Team 2004</li> <li>- Riddle 2001</li> <li>- RUPP Anxiety Study Group 2001</li> <li>- Rynn 2001</li> <li>- Simeon 1990</li> <li>- Wagner 2003</li> <li>- Wagner 2004</li> <li>- Wagner 2004 (Paroxetine)</li> </ul> <p><b>Does not report suicide separately from other outcomes:</b></p> <ul style="list-style-type: none"> <li>- von Knorring 2006</li> <li>- Wagner 2006</li> </ul> <p><b>Ineligible countries:</b></p> <ul style="list-style-type: none"> <li>- Berard 2006 (Belgium, Italy, Spain, Netherlands, South Africa, United Arab Emirates, Argentina, Mexico)</li> </ul>	Placebo-controlled trials of antidepressants in children and adolescents (age <19 years) with MDD, OCD, and non-OCD anxiety disorders

Author, Year of systematic review	Objective of systematic review	Time period and databases searched in systematic review	Potentially eligible studies for the current risk report	Excluded studies for the current risk report	Eligibility criteria in systematic review
Calabria 2010 <sup>76</sup>	To evaluate cannabis-related mortality	January 1990 to January 2008	No eligible studies	<p><b>Studies before 2005:</b></p> <ul style="list-style-type: none"> <li>- Beautrais 1999</li> <li>- Fergusson 2002</li> <li>- Kung 2003</li> <li>- Wilcox 2004</li> </ul> <p><b>Not about suicide:</b></p> <ul style="list-style-type: none"> <li>- Aldington 2008</li> <li>- Andreasson 1990 (Sweden)</li> <li>- Bedard 2007</li> <li>- Blows 2005</li> <li>- Chacko 2006</li> <li>- Drummer 2004</li> <li>- Efird 2004</li> <li>- Hashibe 2006</li> <li>- Laumon 2005 (France)</li> <li>- Llewellyn 2004</li> <li>- Rosenblatt 2004</li> <li>- Sasco 2002</li> <li>- Sidney 1997</li> <li>- Zhang 1999</li> </ul>	Studies with a focus on mortality associated with cannabis use or dependence. General population studies between January 1990 and January 2008 were of most interest.
Chen 2010 <sup>79</sup>	To assess the evidence for an association between sexual abuse and lifetime diagnosis of psychiatric disorders	MEDLINE, EMBASE, CINAHL, Current Contents, PsycINFO, ACP Journal Club, CCTR, CDSR, and DARE between January 1980 and December 2008	<ul style="list-style-type: none"> <li>- Brezo 2008</li> <li>- Fergusson 2008</li> <li>- Pearce 2008</li> </ul> <p><b>All studies reviewed and excluded according to specific inclusion/exclusion criteria for risk report</b></p>	<p><b>Studies before 2005:</b></p> <ul style="list-style-type: none"> <li>- Brown 1999</li> <li>- De Bellis 1994</li> <li>- Dinwiddle 2000</li> <li>- Ernst 1993</li> <li>- Fergusson 2000</li> <li>- Florentine 1999</li> <li>- Garnefski 1992</li> <li>- Harvey 1994</li> <li>- Plunkett 2001</li> <li>- Rimsza 1988</li> </ul> <p><b>Ineligible country:</b></p> <ul style="list-style-type: none"> <li>- Chowdry 2008 (India)</li> </ul>	Longitudinal observational studies that compared individuals who had a history of sexual abuse with a control group

Author, Year of systematic review	Objective of systematic review	Time period and databases searched in systematic review	Potentially eligible studies for the current risk report	Excluded studies for the current risk report	Eligibility criteria in systematic review
Hawton 2005 <sup>63</sup>	To determine main risk factors for suicide and nonfatal suicidal behavior in patients with bipolar disorder	MEDLINE (1966 to December 2003), EMBASE (1980 to December 2003), Biological Abstracts (1985 to December 2003)	No eligible studies	<p><b>Studies before 2005:</b></p> <ul style="list-style-type: none"> <li>- Angst 2002, Angst and Preisig 1995, Angst 1986</li> <li>- Black 1988, Black 1987</li> <li>- Brown 2000</li> <li>- Cassano 1992, Perugi 1988 (Italy)</li> <li>- Coryell 2003, Coryell 2001, Coryell 1992</li> <li>- Coryell 2003, Coryell 2001, Coryell 1992, Coryell 1989, Coryell 1987, Endicott 1985</li> <li>- Dalton 2003</li> <li>- Dunner 1976</li> <li>- Feinman and Dunner 1996</li> <li>- Goldring and Fieve 1984</li> <li>- Grunebaum 2001, Oquendo 2000</li> <li>- Hantouche 2003 (France)</li> <li>- Hoyer 2002 (Denmark)</li> <li>- King 2001</li> <li>- Lenzi 1999 (Italy)</li> <li>- Leverich 2003, Leverich 2002a, Leverich 2002b, Dittmann 2002, Suppes 2001, McElroy 2001 (various including the Netherlands and Germany)</li> <li>- Linkowski 1985 (Belgium)</li> <li>- Lopez 2001 (Spain)</li> <li>- MacKinnon 2003</li> <li>- Maj 1994 (Italy)</li> <li>- Nordstrom 1995 (Sweden)</li> <li>- Osby 2001 (Sweden)</li> <li>- Perugi 1997, Perugi 2000 (Italy)</li> <li>- Potash 2000</li> <li>- Serretti 2002a, Serretti 2002b (Italy)</li> <li>- Stallone 1980</li> <li>- Steblaj 1999 (Slovenia)</li> <li>- Tasi 1999 (Taiwan)</li> <li>- Tasuang 1978</li> <li>- Tondo 1999 (Italy)</li> <li>- Tsai 2002 (Taiwan)</li> <li>- Ucok 1998 (Turkey)</li> <li>- Vieta 1997, Vieta 2001, Vieta 2000, Vieta 1999 (Spain)</li> <li>- Wu 1993</li> <li>- Young 1993</li> </ul>	Investigations of patients with bipolar disorder in which suicide (13 studies) or attempted suicide (23 studies) was reported as an outcome

Author, Year of systematic review	Objective of systematic review	Time period and databases searched in systematic review	Potentially eligible studies for the current risk report	Excluded studies for the current risk report	Eligibility criteria in systematic review
Kallert 2008 <sup>86</sup>	To answer the question: What is the outcome of general psychiatric inpatient care for patients admitted involuntarily compared to patients admitted voluntarily?	Medline (up to March 2006), German PSYINDEXplus (1977 to December 2006)	No eligible studies	<b>Studies before 2005:</b> - Gale 1980 - Read 1993 - Roy 1995	Studies that a) assessed outcomes of involuntary admission and subsequent treatment and outcomes of voluntary admission and subsequent treatment; b) made a statistical comparison between both groups or reported each group's results separately so that a statistical comparison could be computed; c) conducted on general psychiatric wards; d) used either admissions or patients as unit of assessment; e) published in 1980 or later; f) in English or German language; g) reported data on included outcomes
King 2008 <sup>88</sup>	To establish whether lesbian, gay, and bisexual people are at higher risk of mental disorder, substance misuse, suicide, suicidal ideation and deliberate self-harm than heterosexual people and to quantify this risk	Medline, Embase, PsycINFO, CINAHL, Cochrane Library, Web of Knowledge, Applied Social Sciences Index and Abstracts, International Bibliography of the Social Sciences, Sociological Abstracts, the Campbell Collaboration and grey literature databases (January 1966 to April 2005)	No eligible studies	<b>Studies before 2005:</b> - Bagley 1997 - Cochran 2000 - Faulkner 1988 - Fergusson 1999 - Gilman 2001 - Mathy 2002 - Matthews 2002 - Remafedi 1988 - Robin 2002 - Russell 2001 - Skegg 2003	Papers that provided valid definition of sexual orientation and mental health outcomes

Author, Year of systematic review	Objective of systematic review	Time period and databases searched in systematic review	Potentially eligible studies for the current risk report	Excluded studies for the current risk report	Eligibility criteria in systematic review
Large 2011 <sup>89</sup>	To estimate the strength of the association between suicide of psychiatric in-patients and demographic, historical, symptomatic, diagnostic and treatment factors	Medline, PsycINFO, Embase, SINAHL	<ul style="list-style-type: none"> <li>- Hunt 2007</li> </ul> <p><b>Non-Veteran, non-military population</b></p>	<p><b>Studies before 2005:</b></p> <ul style="list-style-type: none"> <li>- Beisser 1961</li> <li>- Gaertner 2002</li> <li>- Gale 1980</li> <li>- Havaki-Kontaxaki 1994 (Greece)</li> <li>- King 2001</li> <li>- Klinkisch 2003 (Germany)</li> <li>- Krupinski 1998 (Germany)</li> <li>- Modestin 1988 (Switzerland)</li> <li>- Modestin 1989 (Switzerland)</li> <li>- Modestin 1992 (Switzerland)</li> <li>- Modestin 1998 (Switzerland)</li> <li>- Powel 2000</li> <li>- Read 1993</li> <li>- Roy 1995</li> <li>- Schlosser 1982</li> <li>- Schlosser 1998</li> <li>- Shah 1997</li> <li>- Sharma 1998</li> <li>- Spiegl 2002 (Germany)</li> <li>- Steblaj 1999 (Slovenia)</li> <li>- Taiminen 1993 (Finland)</li> <li>- Walkfersdorf 2003 (Germany)</li> <li>- Wolfersdorf 2003 (Germany)</li> </ul> <p><b>Ineligible countries:</b></p> <ul style="list-style-type: none"> <li>- Dong 2005 (Hong Kong, China)</li> <li>- Li 2008 (China)</li> <li>- Neuner 2008 (Germany)</li> <li>- Neuner 2010 (Germany)</li> </ul>	<p>1) Reported characteristics of a sample of psychiatric in-patients who had died by suicide either as an inpatient or while on approved or unapproved leave from a mental health facility; 2) Reported characteristics of a control group of psychiatric in-patients who did not commit suicide and who were in-patients in the same or similar mental health facilities at close to the same time as the suicide cases; and 3) Case-control, nested case-control or cohort control design</p>
Maniglio 2011 <sup>91</sup>	To address the best available scientific evidence on the role of child sexual abuse in the etiology of suicide and non-suicidal self-injury	AMED, Cochrane Reviews, EBSCO, ERIC, MEDLINE, PsycINFO, ScienceDirect (January 1966 to December 2008)	No eligible studies	<p><b>Studies before 2005:</b></p> <ul style="list-style-type: none"> <li>- Neumann 1996 (review)</li> <li>- Paolucci 2001 (review)</li> <li>- Rind 1998 (review)</li> </ul> <p><b>Not about suicide:</b></p> <ul style="list-style-type: none"> <li>- Klonsky 2008 (non-suicidal self-injury, review)</li> </ul>	<p>1) Appeared in peer-reviewed journals; 2) published in full; 3) were critical reviews of the literature; 4) were not dissertation papers, editorials, letters, conference proceedings, books, and book chapters; 5) reviewed studies sampling human subjects; 6) investigated medical, neurobiological, psychological, behavioral, sexual, or other health problems following childhood sexual abuse; 7) had primary and sufficient data derived from longitudinal, cross-sectional, case-control, or cohort studies. Only reviews that examined suicidal and non-suicidal forms of self-injury following sexual abuse were included.</p>



Author, Year of systematic review	Objective of systematic review	Time period and databases searched in systematic review	Potentially eligible studies for the current risk report	Excluded studies for the current risk report	Eligibility criteria in systematic review
O'Connor 2009 <sup>95</sup> & O'Connor 2009 <sup>94</sup>	To conduct a systematic review about the benefits and harms of screening adult patients for depression in a primary care setting, the benefits of depression treatment in older adults, and the harms of depression treatment with antidepressant medications	MEDLINE, CCRCT, CDSR, DARE, PsycINFO (1998 to 2007)	<ul style="list-style-type: none"> <li>- Martinez 2005</li> <li>- Simon 2006</li> </ul> <p><b>All non-Veteran, non-military populations</b></p>	<p><b>Studies before 2005:</b></p> <ul style="list-style-type: none"> <li>- Fergusson 2005</li> <li>- Jick 1995</li> <li>- Khan 2003</li> <li>- Storosum 2001</li> </ul> <p><b>Regulatory reviews/analyses of selected drug company data:</b></p> <ul style="list-style-type: none"> <li>- Briefing document 2006</li> <li>- Committee on Safety of Medicines 2009</li> <li>- Gunnell 2005</li> <li>- Hammad 2006</li> <li>- Levenson 2006</li> <li>- Saperia 2006</li> <li>- Stone 2006</li> </ul>	For harms, focused on already-synthesized evidence, supplemented by large observational studies
Perry 2010 <sup>96</sup>	To assess the validity of screening instruments to identify the risk of suicide and self-harm behavior in offenders	11 databases between January 1980 and June 2001 and between January 1980 and November 2004	No eligible studies	<p><b>Studies before 2005:</b></p> <ul style="list-style-type: none"> <li>- Arbola-Florez 1988</li> <li>- Arbola-Florez 1989</li> <li>- Daigle 1999</li> <li>- Earthrowl 2002</li> <li>- Wichmann 2000</li> </ul> <p><b>Not about suicide:</b></p> <ul style="list-style-type: none"> <li>- Perry 2005 (did not assess suicide as an outcome)</li> </ul>	Papers that included an assessment of risk for suicide or self-harm behavior using a screening tool
Platt 2010 <sup>97</sup>	To understand the contribution that access to a means of suicide has on suicide rates within veterinarians	MEDLINE (1950 to May 2008), EMBASE (1980 to May 2008), AMED (1982 to May 2008), BNI (1985 to May 2008), CINAHL (1982 to May 2008), PsycINFO (1806 to May 2008), SCOPUS (to May 2008), Web of Science (1945 to May 2008) and IBSS (1951 to May 2008)	<ul style="list-style-type: none"> <li>- Jones-Fairnie 2008</li> <li>- Mellanby 2005</li> <li>- Stark 2006</li> </ul> <p><b>All studies reviewed and excluded according to specific inclusion/exclusion criteria for risk report</b></p>	<p><b>Studies before 2005:</b></p> <ul style="list-style-type: none"> <li>- Blair 1980</li> <li>- Blair 1982</li> <li>- Botts 1996</li> <li>- Charlton 1993</li> <li>- Charlton 1995</li> <li>- Fasal 1966</li> <li>- Jeyaretnam 2000</li> <li>- Kelly 1998</li> <li>- Kinlen 1983</li> <li>- Lange 1992</li> <li>- Mammerickx 1985</li> <li>- Milham 2001</li> <li>- Miller 1995</li> <li>- Schnurrenberger 1997</li> </ul> <p><b>Ineligible countries</b></p> <ul style="list-style-type: none"> <li>- Agerbo 2007 (Denmark)</li> <li>- Hem 2005 (Norway)</li> </ul>	Included information on suicide, mental illness, stress and other related issues, in relation to veterinary surgeons or studies of veterinary medicine

Author, Year of systematic review	Objective of systematic review	Time period and databases searched in systematic review	Potentially eligible studies for the current risk report	Excluded studies for the current risk report	Eligibility criteria in systematic review
State of Victoria Department of Health 2010 <sup>104</sup>	To outline known risk factors for suicide, examine effectiveness of assessment instruments and interventions for preventing suicide, suicidal behavior and suicidal ideation	MEDLINE, EMBASE, AMED, PsycINFO (January 1997 to February 2009)	<ul style="list-style-type: none"> <li>- Barbui 2009</li> <li>- Bridge 2007</li> <li>- Brown 2005</li> <li>- Carter 2005</li> <li>- Carter 2007</li> <li>- Cooper 2005</li> <li>- Donald 2006</li> <li>- Evans 2005</li> <li>- Fergusson 2005</li> <li>- Hawton 2005</li> <li>- Mann 2005</li> <li>- McMain 2007</li> <li>- McMillan 2007</li> <li>- Nock 2006</li> </ul> <p><b>Bridge 2007 and Hawton 2005 (both systematic reviews) are included in current risk report. All other studies were reviewed and excluded according to specific inclusion/exclusion criteria for risk report.</b></p>	<p><b>Studies before 2005:</b></p> <ul style="list-style-type: none"> <li>- Agerbo 2002</li> <li>- Arsenault-Lapierre 2004</li> <li>- Beck 1999</li> <li>- Cedereke 2002</li> <li>- Evans 2004</li> <li>- Guthrie 2001</li> <li>- Harris 1997</li> <li>- Hawton 2000</li> <li>- Horowitz 2001</li> <li>- Huey 2004</li> <li>- Marshall 2001</li> <li>- Motto 2001</li> <li>- Nimeus 2000</li> <li>- Prinstein 2001</li> <li>- Rotheram-Borus 2000</li> <li>- van der Sande 1997</li> <li>- van der Sande 1997</li> </ul> <p><b>Ineligible countries:</b></p> <ul style="list-style-type: none"> <li>- Qin 2005 (Denmark)</li> <li>- Tidemalm 2008 (Sweden)</li> <li>- Vaiva 2006 (France)</li> </ul> <p><b>Regulatory reviews:</b></p> <ul style="list-style-type: none"> <li>- Gunnell 2005</li> </ul>	English language, human, suicide-related outcome, sample size >6, no duplication, emergency department or other acute care setting
van Lieshout 2010 <sup>105</sup>	To compare efficacy, acceptability and safety of mood stabilizer monotherapy with combination and antidepressant treatment in adults with acute bipolar depression	Medline (1950 to January 2008), Embase (1980 to 2008), PsycINFO (1967 to January 2008), CINAHL (1982 to January 2008), CCRCT and CDSR (to 2008)	<ul style="list-style-type: none"> <li>- Calabrese 2005</li> </ul> <p><b>Non-Veteran, non-military population</b></p>	<p><b>Studies before 2005:</b></p> <ul style="list-style-type: none"> <li>- Calabrese 1999</li> <li>- Tohen 2003</li> </ul> <p><b>Not about suicide:</b></p> <ul style="list-style-type: none"> <li>- Davis 2005</li> <li>- Ghaemi 2007 (suicidal ideation only)</li> <li>- Thase 2006</li> </ul>	Randomized controlled trials of mood stabilizer therapy
Williams 2009 <sup>107</sup> & Williams 2009 <sup>108</sup>	To assess the health effects of routine primary care screening for MDD among children and adolescents aged 7 to 18 years	DARE, CDSR, Medline, PsycINFO (1998 to May 2006)	<ul style="list-style-type: none"> <li>- Olfson 2006</li> </ul> <p><b>Non-Veteran, non-military population</b></p>	<p><b>Studies before 2005:</b></p> <ul style="list-style-type: none"> <li>- Martin 2004</li> <li>- Valuck 2004</li> </ul> <p><b>Ineligible countries:</b></p> <ul style="list-style-type: none"> <li>- Sondergard 2006 (Denmark)</li> </ul> <p><b>Regulatory review:</b></p> <ul style="list-style-type: none"> <li>- Hammad 2006</li> <li>- Kaizar 2006</li> </ul>	Systematic reviews, meta-analyses, and evidence-based guidelines on depression screening, treatment, or associated harms in children and adolescents. For harms, used evidence from randomized controlled trials preferentially, then well-designed non-randomized controlled trials and high-quality observational studies with sample sizes of at least 1,000.

<sup>a</sup> Good quality systematic reviews were defined as scoring 6 or higher (on a 7-point scale) according to the Oxman and Guyatt 1991 criteria.<sup>8</sup>

## APPENDIX H. SUMMARY OF SYSTEMATIC REVIEW RESULTS RELATED TO ASSESSING RISK OF SUICIDE FROM GAYNES ET AL., MANN ET AL., AND NICE REVIEWS<sup>4-6</sup>

	Gaynes 2004 <sup>5</sup>	Mann 2005 <sup>4</sup>	NICE 2011 <sup>6</sup>
<b>Scope</b>			
<b>Search dates</b>	1966-October 2002	1966-June 2005	Up to January 2011
<b>Populations included</b>	Population of interest was primary care patients with previously unidentified suicide risk. Included randomized controlled trials were conducted in high-risk groups as identified by a deliberate self-harm episode, diagnosis of borderline personality disorder, or admission to a psychiatric unit.	Not specified	Adults, children, and young people with previous self-harm behavior
<b>Suicide-related outcomes included</b>	Attempted suicide and death by suicide	Attempted suicide and death by suicide	Primary outcome was repetition of self-harm; also included suicide outcomes.
<b>Settings/countries included</b>	For screening, primary care settings No exclusions based on country	Included settings not specified. No exclusions based on country	No exclusions by country
<b>Additional inclusion/exclusion criteria</b>	For screening, required comparison with a gold standard. Excluded clinical trials targeting patients with chronic psychotic illnesses.		For risk assessment, prospective cohort studies
<b>Main conclusions: Risk assessment tools</b>			
	No studies address the overarching question of whether screening for suicide risk in primary care patients improves outcomes.	Screening for depression in localized geographic areas results in more treatment of depression and lower suicide rates. Further consideration needs to be given to determining the cost-effectiveness of screening general populations vs identified at-risk populations for reducing suicide rates, the predictive validity and reliability of specific screening instruments, and the appropriateness of standard suicide screening instruments across different cultures.	<i>Tools to predict suicide:</i> 6 studies (all cohort designs) looked at predicting a fatal outcome such as suicide in people who have self-harmed. Limitations are high false positive rates in scales with the highest sensitivity, use of small samples of mainly people with suicidal ideation, and long follow-up periods to increase prevalence. Because of these limitations, the use of scales to predict the risk of suicide cannot be recommended in clinical practice. <i>Tools to predict repetition of self-harm:</i> The strongest evidence was from prospective cohort studies, conducted mostly in participants who presented to an emergency department following self-harm. All the scales had relatively low positive predictive values ranging from 12% to 60%. This means that many individuals were wrongly identified as people who would repeat self-harm, thus limiting the clinical utility of these scales and possibly resulting in unnecessary intervention in some individuals.

## APPENDIX I. DATA ABSTRACTION FOR PRIMARY STUDIES RELATED TO ASSESSING RISK OF ENGAGING IN SUICIDAL SELF-DIRECTED VIOLENCE AMONG MILITARY AND VETERAN POPULATIONS

Author, Year	Population, Setting, Sample Size	Study Design	Outcome	Risk Factors/ Covariates Included in Assessment Calculation	Results	Validation of Assessment Tool	Appropriate for Primary Care Settings
Breshears 2010 <sup>13</sup>	154 Veterans with TBI who received care at a VA for at least five years; no history of neurologic disease or non-TBI.	Prospective cohort	Suicide and suicidal behavior	Mental health diagnoses, age, gender, level of education, age at TBI, race/ethnicity, years since TBI, TBI severity, history of substance abuse, Negative Impression scale	Hierarchical multiple regression results: SPI and Suicidal Ideation Scale subscales from the PAI incrementally contributed to prediction of post-PAI suicidal behavior beyond pre-PAI suicidal behavior alone; only SPI remained a significant predictor when other risk factors were included in the model. SPI cutoff score of $\geq 15$ , sensitivity was 0.909 and specificity was 0.951, with a false positive rate of 5%.	PAI validity information cited	No; PAI is over 100 items and requires a computer program to score. Recommended use is by psychologists as part of an assessment.
Hartl 2005 <sup>14</sup>	630 male Veterans with a primary PTSD diagnosis who consecutively entered the residential treatment program for PTSD at the Palo Alto VA between July 1994 and December 2000. Patient referred to the program by medical and mental health staff in the Pacific Northwest. Mean age 51 (Standard deviation [SD] 4.55, range 26-76). 60% Caucasian, 13% Hispanic, 90% Vietnam era Veterans, 86% had served in combat. 72% had a history of incarceration.	Prospective cohort	Suicide attempt	Suicide attempt in the past four months and ever, BDI score, substance use, demographics, combat history	The single best predictor of a suicide attempt after discharge was having attempted suicide in the 4 months prior to intake ( $\chi^2$ [df1,296]=15.03, $p < 0.001$ ). Among those who had not attempted suicide shortly before intake, the next optimal predictor was patients' BDI scores (BDI $\geq 46$ vs $< 46$ ): $\chi^2$ (df 1252)=10.54, $p < 0.001$ . Sensitivity for this model calculated at 0.63, with a specificity of 0.80. In a replication sample, the model resulted in sensitivity of 0.11 and specificity of 0.84.	BDI validity information cited. Replication sample results reported in this paper	Yes; BDI is frequently used in primary care contexts, is brief, and easy to administer and score.
Hendin 2010 <sup>15</sup>	283 in- and outpatients at a VAMC with affective or affective plus substance abuse or anxiety disorders.	Prospective cohort	Suicide and suicidal behavior	Depression and disability/functioning	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 $\geq 3$ , the ASQ resulted in sensitivity of 0.60 and specificity of 0.74.	Article cites pilot testing of the measure in a sample of 254, and reports reliability of 0.77 and a single factor structure for the current sample	Yes; 7-item questionnaire.

Author, Year	Population, Setting, Sample Size	Study Design	Outcome	Risk Factors/ Covariates Included in Assessment Calculation	Results	Validation of Assessment Tool	Appropriate for Primary Care Settings
Nademin 2008 <sup>16</sup>	60 active duty members of the Air Force who died by suicide over a 10 year period and 122 active duty members of the Air Force matched on age, race, gender, and marital status.	Retrospective cohort	Suicide	Gender, race, marital status	IPS total score associated with 1.27 increased odds of suicide when comparing groups after adjustment for age, gender, race, and marital status.	Measure responses were self-report (comparison group) vs estimated by assessors (sample who died by suicide), therefore validity and comparability of surveys is questionable given the sample. IPS included as appendix; other surveys were cited and reliability information reported.	IPS is 34 items; Acquired Capability to Suicide Scale is 20 items; Interpersonal Needs Questionnaire is 25 items. All too long for brief screening in a primary care setting and more appropriately used as part of an in-depth psychological assessment.
Tiet 2006 <sup>17</sup>	34,251 people seeking substance abuse treatment at 150 VAMCs nationally.	Cross-sectional	Suicide attempt	Age, education, gender, race, marital status, employment status, psychiatric diagnoses, suicide history	Decision tree provided comparing rates of suicide attempts for patients grouped according to suicide attempt/ ideation history, recent alcohol abuse, recent cocaine abuse, violent behavior, hallucinations, and employment status, as these variables were the significant predictors of suicide attempt in the population studied.	ASI validity information cited.	ASI is a structured, clinical interview designed to be conducted as part of an intake for a substance abuse treatment program. The clinical interview is lengthy, must be completed by a provider trained in substance abuse treatment, and is not appropriate for brief screening or primary care settings.

## APPENDIX J. RISK OF BIAS RATINGS FOR PRIMARY STUDIES RELATED TO ASSESSING RISK OF ENGAGING IN SUICIDAL SELF-DIRECTED VIOLENCE AMONG MILITARY AND VETERAN POPULATIONS<sup>a</sup>

Author, Year	1. Adequate description of population	2. Non-biased selection	3. Low loss to follow-up/ missing data?	4a. Standardized method of risk factor assessment and scoring clearly described or referenced	4b. Unbiased risk factor assessment by independent assessors?	5a. Adequate outcome measurement?	5b. Unbiased outcome measurement by independent assessors?	6. Adequate accounting for potential confounders?	Overall assessment of potential for bias (Low/Unclear/High)
Breshears 2010 <sup>13</sup>	Yes	Unclear - does not specify consecutive patients, and chart review used to determine which patients met inclusion criteria	Unclear - included only patients with sufficient information in the medical record to confirm TBI and assess injury severity	Unclear - all risk factors were assessed via chart review, though the PAI scoring and reporting is likely standardized even in patients' charts	Unclear - no description of assessor independence or blinding	No - chart review was used as the reference standard for post-PAI suicidal behavior	Unclear - no description of assessor independence or blinding	Yes - though study design was retrospective chart review, all PAI assessments occurred prospectively in relation to suicide-related events, and therefore all potential participants were prospectively assessed as part of one cohort	High
Hartl 2005 <sup>14</sup>	Yes	Yes - consecutive admissions	Unclear - missing data not reported, but used information typically collected at the outset of most treatment programs	Unclear - questionnaires at intake, but the questionnaires themselves were not described or cited. Did not report how patients' war zone trauma exposure was collected. Treatment-related variables are likely to be most accurate for readmissions to this program, less so for admissions from other programs.	Unclear - no description of assessor independence or blinding	Unclear - suicide attempts assessed by the Northeast Program Evaluation Center survey, which is adequately cited, though suicide attempt items are reportedly added to the survey and not standard items	Unclear - no description of assessor independence or blinding	Yes - prospective assessment of a single cohort	High
Hendin 2010 <sup>15</sup>	Yes	Unclear - no description of consecutive or random sample of patients	Yes - 240/283 patients completed both assessments	Yes - standardized procedures and assessment tools described	Yes - states that research assistant assessors were independent	Yes - standardized procedures and assessment tools described. All patients were assessed at follow-up regardless of assessed risk.	Unclear - no description of assessor independence or blinding for outcome assessment	Yes - prospective study design of a single population	Unclear

Author, Year	1. Adequate description of population	2. Non-biased selection	3. Low loss to follow-up/ missing data?	4a. Standardized method of risk factor assessment and scoring clearly described or referenced	4b. Unbiased risk factor assessment by independent assessors?	5a. Adequate outcome measurement?	5b. Unbiased outcome measurement by independent assessors?	6. Adequate accounting for potential confounders?	Overall assessment of potential for bias (Low/Unclear/High)
Nademin 2008 <sup>16</sup>	Yes	Unclear - abstract states that the study had random sample of people who died by suicide; unclear description for comparison group	Yes - 5% missing data from suicide cases (3/60) and 3% from controls (4/122)	Unclear - psychological autopsy format used to assess mental state and situation based on review of records containing primarily third-person reports. However, used a standardized coding template (Suicide Death Investigation Template) developed by the authors and administered by trained coders that had high inter-rater reliability. Self-report measures used for living comparison sample.	Unclear - no description of assessor independence or blinding	Yes - included deaths by suicide from closed files (no longer under investigation)	Unclear - no description of assessor independence or blinding	No - groups differed with respect to race, marital status, and gender but appropriate statistical adjustments were performed. However, groups likely differed on multiple other un-assessed criteria due to the retrospective design of the study.	High
Tiet 2006 <sup>17</sup>	Yes	Unclear - recruitment time frame not described	Yes - only 2% missing data (95/5671) from Figure 1	Yes - addiction and suicidal ideation: assessed by face-to-face interview with a validated questionnaire (ASI). Psychiatric diagnoses: accessed nationwide VA database to obtain diagnoses made by experienced clinicians during usual care.	Unclear - no description of assessor independence or blinding	Yes - assessed during face-to-face interview with validated questionnaire (ASI)	Unclear - no description of assessor independence or blinding	Yes - all data collected at a single time point from a single population	Unclear

<sup>a</sup> Risk of Bias tool modified from Hayden et al. 2006 and Harris et al. 2001.<sup>9, 10</sup>

## APPENDIX K. DATA ABSTRACTION FOR PRIMARY STUDIES OF FACTORS TO PREDICT SUICIDAL SELF-DIRECTED VIOLENCE IN MILITARY AND VETERAN POPULATIONS

Author, Year	Study design	Aim of study	Sample size	Data source, sample time frame, location	Population characteristics	Comparison group (if any)	Risk factor(s) measured	Method of measurement of risk factor(s)	Length of follow-up/ observation time	Statistical analysis methods/ Control for confounding	Results
Belik 2009 <sup>18</sup>	Cross-sectional	Determine whether exposure to particular types of traumatic events was differentially associated with suicide attempts	8441	Canadian Community Health Survey Cycle 1.2 - Canadian Forces Supplement (CCHS-CFS)	Canadian military personnel, active military within past 6 months, ages 16-54: 5155 regular force members and 3286 reserve force members	Suicide cases vs non-suicide cases	Exposures to 28 traumatic events during their lifetime, socio-demographics (age, marital status, income, education, rank, type of service), and mental disorders	Traumatic events - 28 items from the PTSD section of the Composite International Diagnostic Interview (CIDI). Socio-demographic variables. Mental disorders - survey based on responses to questions from the CIDI. Alcohol use from the CIDI short form. Lifetime suicide attempts: ever attempted suicide or tried to take own life.	Not applicable (N/A)	All analyses stratified by sex. 3 models: 1) unadjusted; 2) adjusted for socio-demographic factors; and 3) adjusted for socio-demographic factors, the presence of any lifetime mental diagnosis, and a comorbidity variable (3 or more mental disorders). Used p<0.01 in order to account for multiple comparisons.	7 categories: 5 groups of trauma (deployment related, accident or other unexpected, sexual trauma, other interpersonal, civilian in war zone or refugee) and "event happened to other," "other trauma" - 28 individual variables. <u>Males (OR, 95% CI) for suicide attempt:</u> Having purposely injured or killed: 2.69 (1.09-6.61) Toxic chemical exposure: 1.86 (1.09-3.18) Life-threatening illness: 2.25 (1.04-4.89) Civilian in religious terror: 2.38 (1.00-5.72) <u>Females (OR, 95% CI) for suicide attempt:</u> Man-made disaster: 2.16 (1.02-4.55) Child abuse: 2.34 (1.15-4.75) Abused by other person: 3.08 (1.04-9.14) Witness to domestic violence: 1.73 (1.00-3.01) Stalked: 1.86 (1.09-3.19)
Belik 2010 <sup>19</sup>	Cross-sectional	Compare the prevalence and correlates of suicidal behavior in active duty vs civilian population	36,984 total; 8441 military who completed the CCHS-CFS	CCHS-CFS	Nationally representative Canadian sample, age 15 or older, surveyed between 2001-2002	Compared military to civilian; results presented for military personnel separately	Demographics (education, marital status, income), military rank, regular/ reserve service, environment, number of deployments, combat exposure	Survey	N/A	Logistic regression	<u>Adjusted OR (95% CI) for suicide attempt in past year:</u> Depressive episode: 80.73 (24.78-262.96) Panic attack: Not significant (NS) Social phobia: 11.11 (3.65, 33.80) Alcohol use: NS Alcohol dependence: 12.51 94.13-37.90) Generalized anxiety disorder: 44.80 (16.12-124.49) PTSD: 26.76 (9.37-76.48) <u>Unadjusted OR (95% CI) for suicide attempt in past year:</u> More senior rank protective (vs junior rank): 0.71 (0.24-3.15) for officer, 0.93 (0.28-2.08) for senior Reserve (vs regular): 0.28 (0.08-0.97) More deployments (vs 0): 0.10 (0.01-2.16) for one, 0.61 (0.11-3.41) for two, 0.69 (0.06-8.53) for 3 or more Higher odds of suicide attempts for communications/air/sea vs land: 1.23 (0.49-3.13) Combat exposure: 1.83 (0.45-7.53)



Author, Year	Study design	Aim of study	Sample size	Data source, sample time frame, location	Population characteristics	Comparison group (if any)	Risk factor(s) measured	Method of measurement of risk factor(s)	Length of follow-up/ observation time	Statistical analysis methods/ Control for confounding	Results
Bell 2010 <sup>20</sup>	Case control	Determine the association between prior injury, alcohol, and mental health disorder hospitalizations and independent predictors for suicide	1873 suicides and 5619 controls	Total Army Injury and Health Outcomes Database, included army casualty (death) files, inpatient hospital data from the Army Individual Patient Data system and personnel records from the Defense Manpower Data Center	Suicides between 1/1/1990 and 12/31/2003	Suicides compared to controls (controls selected on a 3:1 ratio to cases using the incident suicide date to identify eligible controls based on active-duty status at the time of the suicide)	Demographics, hospitalization experiences (ICD), mental health related hospitalizations, alcohol related diagnoses and non-alcohol related mental health disorders. Service grade, officer status (warrant, commissions)	ICD-9 codes	N/A	Logistic regression: 1) all hypothesized risk factors included; 2) interaction terms for injury, alcohol and mental disorder hospitalizations with each of the other background variables in the model	<u>Adjusted analyses (adjusted OR, 95% CI) for suicide:</u> Protective factors include: time in service (0.97, 0.95-0.99); black vs white (0.64, 0.56-0.74); college education vs none (0.69, 0.55-0.87); warrant office status (0.48, 0.25-0.94); and commissioned officer status (0.66, 0.47-0.93). Risk factors include: male gender (2.73, 2.12-3.55); prior injury hospitalization (2.04, 1.64-2.54); prior alcohol hospitalization (3.41, 2.32-4.99); and mental disorder hospitalization (6.62, 4.77-9.20). Significant interactions for: alcohol and mental disorder and injury hospitalization (0.16, 0.15-0.53); mental disorder and injury (65.55, 15.27-281.45); mental disorder, alcohol and injury (5.99, 1.45-24.80); and injury and mental disorder (16.07, 3.75-68.77).
Brenner 2011 <sup>21</sup>	Cross-sectional	Examine the association between TBI and suicide among individuals receiving care through the VHA	Case control study with 81 cases and 160 matched controls (92 cases had only 1 control)	Cases of suicide death/ suicide attempt were identified between October 2004 and February 2006	Patients who received care from the VAMC and had an EMR note documenting a suicide attempt. Archival data from a large western VAMC. Where possible, two possible patients per case were randomly selected from 3,239 potential patients (chart review to confirm absence of suicide attempt or death).	Controls matched for age and gender, chart review confirmed no suicide in the control group. In two cases only 1 control could be identified vs 2.	PTSD, TBI, neurologic disease	Key word search of the chart	N/A	Conditional logistic regression, controlling for age and gender	<u>Univariate analyses:</u> TBI and neurologic conditions were not significantly associated with suicide attempt/death (OR 1.03; 95% CI, 0.57-1.86 for TBI and OR 0.38; 95% CI, 0.08-1.80 for neurologic diseases). PTSD was associated with suicide attempt (OR 2.79; 95% CI, 1.53-5.07). In the model that included both PTSD and TBI, TBI was NS (OR 0.87; 95% CI, 0.47-1.61) but PTSD remained significant (OR 2.85; 95% CI, 1.55-5.22).
Brenner 2011 <sup>22</sup>	Cross-sectional	Examine the association between TBI and suicide among individuals receiving care through the VHA	49,626 with TBI plus a 5% random sample of patients without TBI (n=389,053)	Individuals who received care within the VHA between 2001-2006	All patients with TBI (n=49,626) plus a 5% random sample of patients without TBI (n=389,053). Of those with TBI, 105 died by suicide.	Those with TBI compared to those without TBI	Substance abuse, bipolar disorder I/II, MDD, other depression, other anxiety, PTSD, schizophrenia/ schizoaffective disorder, age, gender	TBI identified by ICD-9 codes, according to most severe diagnosis. Discharge diagnoses that included epilepsy were excluded.	N/A	Models adjusted for demographic and psychiatric covariates	Veterans with TBI were 1.55 (95% CI, 1.24-1.92) times more likely to die by suicide than those without a history of TBI, after controlling for psychiatric comorbidities. Any TBI adjusted HR: 1.55 (95% CI, 1.24-1.92) Concussion/fracture HR: 1.98 (95% CI, 1.39-2.82) Cerebral contusion/traumatic intracranial hemorrhage: HR 1.34 (95% CI, 1.09-1.64)

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Cox 2011 <sup>23</sup>	Cross-sectional	Identify gender differences among those admitted for suicidal thoughts and behaviors	656 (465 admitted for suicidal thoughts and 191 for suicidal behaviors)	Random sample of EMRs from patients admitted to large US Army hospital for suicide-related thoughts or behaviors from 2001-2006	Demographics not reported separately for the suicidal behaviors group. Overall 36% women, 61% white, 37% married. Men were more likely to have high school or equivalent as highest educational level, have military rank of E4-6, and have a diagnosis of adjustment disorder. Women were more likely to have unknown educational attainment, be black, and have no military rank (retired or dependent).	Men vs women	Childhood trauma (including sexual abuse, physical abuse, neglect, domestic violence, unspecified trauma), adult trauma (including sexual assault, physical assault, emotional and psychological abuse, military combat, pregnancy loss, unspecified trauma), and number of types of trauma	Chart review	N/A	Regression analyses. 2 sets: Set 1) adjusted for age, race, education, income, military rank, marital status, MDD, dysthymic disorder, bipolar disorder, PTSD, substance or alcohol abuse/ use disorder, adjustment disorder and ≥3 lifetimes psychiatric disorders; Set 2) all the above plus other trauma types	For those admitted with suicide-related behaviors, there were no differences between men and women after adjustment for all types of trauma (Set 2).
Desai 2005 <sup>24</sup>	Prospective cohort	Identify risk factors for suicide among psychiatric inpatients	121,933 individuals; 481 suicides within 1 year of discharge	All patients discharged with a diagnosis of major affective disorder, bipolar disorder, PTSD, or schizophrenia from psychiatric inpatient units in the VA system between 1/1/1994 to 12/31/1998	94% male, 68% white, 44% previously married, 52% not service connected. 25% with alcoholism, 11% with substance abuse, 40% with schizophrenia, 19% with bipolar disorder, 27% with depression, 29% with PTSD.	Suicides vs non-suicides among all discharges from VA inpatient psychiatric unit.	Administrative data available from the patient treatment file: age, race, marital status, service-connected disability status, year of inpatient discharge, type of discharge (community or institution), distance from home to nearest VAMC, and psychiatric diagnosis. Six variables about care delivery: length of stay, readmission, total number of inpatient days in the 6 months after discharge, whether patient had an outpatient visit in 6 months after discharge, and number of 2-month periods in the 6 months following discharge in which the patient had 2 outpatient visits for primary discharge diagnosis. Facility-level variables and social environment variables (community level).	Individual risk factors: from the patient treatment file Delivery-of -care variables: from the patient treatment file and the outpatient care file (database of all VA outpatient care) Facility-level variables: source not reported. Social environment variables: statewide adjusted suicide rates from the Centers for Disease Control and Prevention mortality reports; minority population from Census Bureau.	12 months following discharge	Calculated suicide rate for each facility. Expected mortality rates were calculated using multivariate logistic regression adjusting for age, gender, race, disability, distance to the VAMC, year of discharge, diagnosis and discharge to the community. Individual variables assessed using Poisson regression.	Quality of care measures associated with suicide mortality among patients discharged from VA inpatient psychiatric programs. (Rate Ratio, p-value): <u>Length of stay:</u> <7 days: 1.41, p<0.04 ≥7-14 days: 1.33, p<0.03; ≥14-30 days: 1.11, p=0.048 <u>Time to readmission:</u> 14 days: 0.81, p=0.26 30 days: 0.79, p=0.13 180 days: 0.55, p=0.0001 <u>Inpatient days in 6 months:</u> 1.01, p=0.0001 <u>Outpatient visit within 30 days:</u> 1.04, p=0.75 <u>Outpatient visits in 6 months:</u> 1.00, p=0.37 <u>Continuity of care (reference 3):</u> 0: 1.06, p=0.84 1: 1.59, p<0.03 2: 1.01, p=0.97

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Hartl 2005 <sup>14</sup>	Prospective cohort	Identify patients at high risk for negative behavioral outcomes including suicide attempts	620 in total sample; 409 in the development cohort and 221 in the validation cohort	Intake surveys and clinical diagnostic interviews	630 male Veterans with a primary PTSD diagnosis who consecutively entered the residential treatment program for PTSD at the Palo Alto VA between July 1994 and December 2000. Patients referred to the program by medical and mental health staff in the Pacific Northwest. Mean age 50 (SD 4.55, range 25-76). 60% Caucasian, 13% Hispanic, 90% Vietnam era Veterans, 86% had served in combat. 72% had a history of incarceration.	Validation cohort was 2/3 of the overall sample (n=221)	Suicide attempt in past 4 months and ever, BDI score, substance use, demographics, combat history	Variables obtained from intake questionnaires: age, ethnicity, education, marital status, history of incarceration. Suicide attempts assessed with survey: 1) in lifetime, and 2) in last 4 months. Structured clinical interview for the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV), including alcohol, cannabis, and hard drugs (cocaine, amphetamine, opioid dependence)	4 months	Sensitivity and specificity calculated in the replication sample. Used receiver operating characteristic curves to classify people as high/low risk.	"The single best predictor of a suicide attempt after discharge was having attempted suicide in the 4 months prior to intake ( $\chi^2(df1,296)=15.03, p<0.001$ ). Among those who had not attempted suicide shortly before intake, the next optimal predictor was patients' BDI scores (BDI $\geq 46$ vs $<46$ ): $\chi^2(df1252)=10.54, p<0.001$ . Sensitivity for this model calculated at 0.63, with a specificity of 0.80."
Ilggen 2007 <sup>28</sup>	Prospective cohort	Develop a model of risk and protective factors for clinical prediction of future suicide attempt	8807	Cohort of 13,870 patients who received the ASI within 2 weeks of treatment entry into 1 of 149 non-methadone psychosocial facilities in the US; of these 64% provided follow-up data on the ASI an average of 13 months later and are included in the analysis. Additional follow-up data were derived from interviews and self-report assessments.	Mean age: 47 years (SD 9.6). Mean years of education: 13 (SD 2) 96% male 59% Caucasian; 32% African American; 5% Hispanic/Latino; 4% other race/ethnicity. 21% married 38% reported full-time employment	Suicides vs non-suicides in this cohort	Individual items on the ASI as candidate risk factors.	Baseline: ASI Follow-up: ASI plus interview Treatment factors included: 1) number of days of contact with a substance use disorder treatment provider, and 2) number of days of contact with a psychiatric provider	1 year	MacArthur Model – a series of mixed-model logistic regression analyses including main effects of each pair of candidate risk factors and their interaction	314 of 8807 patients (3.6%) reported a suicide attempt within the 30 days prior to their follow-up assessment. 33 items from baseline and 1 treatment factor identified as significant in univariate analyses. OUTCOME: suicide attempt approximately 1 year after entering substance use disorder treatment (assessed as attempt within 30 days prior to assessment). Risk factors: Elevated suicidal/psychiatric symptoms (value=0.73, t-value=10.62, p=0.001); alcohol problems (value=0.02, t-value=3.70, p=0.001); cocaine-adjusted life years (value=0.02, t-value=4.14, p=0.001) Protective factors: Criminal justice system involvement (value=-0.60, t-value=3.60, p=0.001); substance use disorder treatment participation (number of days): (value=-0.08, t-value=5.36, p=0.001)

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Ilggen 2009 <sup>27</sup>	Longitudinal	Develop and validate a decision tree using recursive partitioning	887,859 VA patients treated for depression (diagnosis of depression and treatment with antidepressant, or diagnosis of depression during two separate visits) between April 1, 1999 and September 30, 2004. 1892 suicides (ICD-9 and NDI). Of 887,859 patients, 589,825 randomly selected for primary/development sample and 298,034 selected for the replication sample.	VA's National Registry for Depression (NARDEP) linked to the NDI, April 1, 1999 to September 30, 2004. NDI queries were submitted for all those with date of death in the study period according to VA Beneficiary Identification and Records Locator System; also initiated NDI searches for patients who did not use VA services in the year following the study period even if there was no date of death for these patients in VA data system.	Primary cohort (n=589,825): Age: 58.62 years (SD 14.38) 91.9% male Race/ethnicity: 76.4% White; 12.4% Black; 2.2% Other; 9.0% Unknown; 4.7% Hispanic. Substance use: 22.1% PTSD: 22.1% Inpatient psychiatric stay in past 12 months: 3.6% Service connection: 31.6%  No significant difference between primary and secondary cohorts	Suicide vs non-suicide	Derived from patient records: age, race, sex, substance use disorder diagnosis, diagnosis of PTSD, prior VA hospitalization for any psychiatric diagnosis in the year prior to cohort entry, service connection, and baseline medical comorbidity (sum of all conditions in the past year included in the Charlson Comorbidity Index)	Derived from patient records, not further described	Study period was April 1, 1999 through September 30, 2004. Assessment of risk factors could have been done at any time. Suicide deaths were assessed during the study period and in the year following the study period.	Bayesian Dirichlet Equivalent methods for identification of the strongest predictor - data mining process to examine possible higher-order relationships between predictors	Overall suicide 89.55/100,000 person-years (PYs) in the primary sample of depressed Veterans. <u>Among depressed VA patients with substance use disorder</u> African Americans were significantly less likely to die by suicide than individuals of any other race. In African Americans with substance use disorder, no other variables reliably distinguished those who did vs those who did not die by suicide. In non-African Americans, having been admitted to inpatient psychiatric treatment at least once in the prior 12 months conferred an additional risk for suicide vs those with no psychiatric admission (247.21/100,000 PYs vs 143.05/100,000 PYs). <u>Among depressed VA patients without substance use disorder</u> sex was the strongest indicator of suicide risk: 82.08/100,000 PYs for men vs 26.22/100,000 PYs for women. In women, no other available risk factors reliably identified individuals at differing levels of risk. In men, race was related to suicide risk: African American men 33.30/100,000 PYs vs non-African American men 86.78/100,000. The replication sample confirmed that the groups defined by the development cohort significantly discriminated suicides from non-suicides. <u>OR from the primary cohort (95% CI):</u> Any substance use disorder: 2.0 (1.8-2.2) Non- African Americans with substance use disorder: 5.6 (3.7-8.6) Non- African Americans with substance use disorder and any inpatient psychiatric treatment in past 12 months: 2.0 (1.6-2.5) Men without substance use disorder: 2.9 (2.0-4.2) Non- African American men without substance use disorder: 2.6 (1.8-3.8)

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Ilggen 2010 <sup>25</sup>	Prospective cohort	Examine the strength of association between psychiatric diagnoses and risk of suicide	All Veterans who used VA services during FY 1999 (n=3,291,891) who were alive at the start of FY 2000	CDC's NDI data and VA National Patient Care Database	90% male Age: 18-29: 4.1% 30-39: 8% 40-49: 17.1% 50-59: 21.5% 60-69: 19.8% 70-79: 23% ≥80: 6.5% Any psychiatric diagnosis: 25.6% Any substance abuse or dependence: 10% Alcohol abuse or dependence: 8.5% Drug abuse or dependence: 5.7% Bipolar disorder: 2.9% Depression: 14.5% Other anxiety: 7.3% PTSD: 6.3% Schizophrenia: 4.1%	Those with suicide during follow-up period vs those without suicide	Any psychiatric diagnosis, substance abuse or dependence, alcohol abuse or dependence, drug abuse or dependence, bipolar disorder, depression, other anxiety, PTSD, and schizophrenia	All psychiatric diagnoses were based on ICD-9 codes given during a visit in FY 1998 or FY 1999. Categories were not mutually exclusive (patients could have multiple diagnoses).	Observation period began the first day of FY 2000 and ended the last day of FY 2006 or the date of suicide	Data censored on date of death for those who died from causes other than suicide during the observation period. Conducted a series of proportional hazards regression models for each variable of interest, then used covariance sandwich estimators to adjust for clustered data (nested within VHA facilities); then proportional HR models examined the HR of suicides for each diagnosis individually, adjusted for age group and stratified by sex.	Suicide mortality was 11.6/100,000 PYs for women and 40.9/100,000 PY for men. 70% had any psychiatric diagnosis at baseline. Age-adjusted HR (95% CI) for Suicide During FY 1999 to FY 2006 in all VHA patients treated in FY 1999 who were alive at the start of FY 2000: <u>Male:</u> Any psychiatric diagnosis: 2.50 (2.38-2.64) Any substance abuse or dependence: 2.27 (2.11-2.45) Alcohol abuse or dependence: 2.28 (2.12-2.45) Drug abuse or dependence: 2.09 (1.90-2.31) Bipolar disorder: 2.98 (2.73-3.25) Depression: 2.61 (2.47-2.75) Other anxiety: 2.10 (1.94-2.28) PTSD: 1.84 (1.70-1.98) Schizophrenia: 2.10 (1.93-2.28) <u>Female:</u> Any psychiatric diagnosis: 5.18 (4.08-6.58) Any substance abuse or dependence: 6.62 (4.72-9.29) Alcohol abuse or dependence: 6.04 (4.14-8.82) Drug abuse or dependence: 5.33 (3.58-7.94) Bipolar disorder: 6.33 (4.69-8.54) Depression: 5.20 (4.01-6.75) Other anxiety: 3.48 (2.52-4.81) PTSD: 3.50 (2.51-4.86) Schizophrenia: 6.08 (4.35-8.48)

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Ilggen 2010 <sup>29</sup>	Prospective cohort	Determine the association between self-reported pain severity and suicide among Veterans	260,254 total cohort - identified 903 as having died by suicide	FY 1999 LHSV, VA medical records, and suicide deaths identified by the NDI during FY 1999-FY 2006. Patients had to have usable data from the LHSV, be alive at the start of FY 2000 and be included in at least one of the following data sources: National Psychosis Registry, NARDEP; or a random sample of all patients who used VA services in FY 1999 who were not part of other registries. 31,716 were in the National Psychosis Registry and 104,516 were in the NARDEP; of these, 16,074 were in both – these duplicates were eliminated. Data on 120,158 individuals merged with 140,096 from the random sample.	94.68% male Age: <50 years: 19% 50-64: 33% ≥65: 48% Race: 75% White; 13% Black; 12% Other. Married/ cohabitating: 56% Education: Not a high school graduate: 26% High school through some college: 32% College graduate: 42%. Smoker: 32.5% Mean MCS-12 score: 37.8 (SD 13.7) Mean Physical Component Summary-12 score: 33.2 (SD 11.2) For psychiatric and medical comorbidities, see Table 2 of the article.	Suicides vs non-suicides	Risk Factors: Pain: measured with a single question on the LHSV – "how much bodily pain have you had during the past 4 weeks?" (from the SF-36). Other factors: demographics (age, gender, race), diagnosed psychiatric comorbidities, educational status, smoking, marital status, medical diagnosis by ICD-9. Outcome: death by suicide, defined by the presence of any of the following ICD-10 codes as NDI cause of death from 2000-2006: X60- X84, Y87.0 (McCarthy, 2009). <sup>47</sup>	ICD-9 codes for psychiatric diagnosis and medical diagnosis	Deaths evaluated from FY 2000 (October 1, 1999) to FY 2006 (September 30, 2006) – total of 7 years	Cox proportional hazards regression	Multivariate results for suicide, HR (95% CI): <u>Demographics:</u> Age ≥65 vs <50: NS Age 50-64 vs <50: NS Male gender: 2.14 (1.46-3.14) Black race vs white: 0.33 (0.25-0.44) Other race vs white: 0.75 (0.61-0.92) Not a high school graduate: NS High school graduate/some college: NS Smoker: 1.71 (1.48-1.97) <u>Psychiatric Comorbidity:</u> Schizophrenia: 1.52 (1.24-1.86) Bipolar disorder I or II: 1.53 (1.22-1.92) Depression: 1.27 (1.10-1.46) Other anxiety: 1.28 (1.07-1.54) Drug use disorder: NS <u>Medical Comorbidity:</u> Diabetes: 0.66 (0.53-0.82) Complicated diabetes: NS Cerebrovascular disease: 0.66 (0.47-0.91) Cancer: NS <u>Other:</u> MCS-12: 0.98 (0.97-0.99) Physical Component Summary-12: NS Severe pain vs moderate or less pain: 1.33 (1.15-1.54)

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Ilggen 2010 <sup>26</sup>	Prospective cohort	Examine the demographic and clinical predictors of violent and nonviolent suicide among patients with substance use disorders compared to non-suicide controls	Total n= 5082 854 Suicides and 4229 patients who did not die by suicide during the study period selected randomly.	VA medical records and the NDI. Included VA patients with substance use disorders who were alive at the beginning of FY 2002 and died by suicide during FYs 2002-2006 (n=854) and a random sample of 4228 substance use disorder patients who did not die by suicide during this period.	97% male 28% Black; 58% White; 14% Unknown/other. Age: 18-44 years: 22% 45-64 years: 66% ≥65 years: 11.5% Region: 22.4% Northeast; 30% South; 26% Central; 21.5% West	Random sample of substance use disorder patients who did not die by suicide was the comparison group for both violent suicide and non-violent suicide	Gender, age, race, region, mental conditions (major depression, other anxiety disorder, bipolar disorder, PTSD, schizophrenia, personality disorder, to or more psychiatric disorders), and substance use disorders (alcohol, cocaine, cannabis, opiate, amphetamine, barbiturate, multiple/other)	ICD-9 codes for substance use disorders and mental diagnoses. Demographic information from the databases. Diagnosis of substance use disorder was defined as patients who received two or more diagnoses of the same substance use disorder from FYs 1997-2001.	4 years	Logistic regression controlling for gender, race, age, and region.	OR (95% CI) for violent suicides (VS) and non-violent suicides (NVS), compared to those who did not commit suicide: <u>Mental conditions:</u> Major depression: VS 2.09 (1.75-2.50); NVS 4.94 (2.99-5.19) Other anxiety disorder: VS 1.87 (1.55-2.25); NVS 3.26 (2.51-4.25) Bipolar disorder: VS 1.62 (1.32-2.00); NVS3.18 (2.42-4.18) PTSD: VS 1.33 (1.10-1.62); NVS 2.23 (1.70-2.92) Schizophrenia: VS 1.49 (1.20-1.84); NVS 2.57 (1.94-3.40) Personality disorder: VS 1.56 (1.27-1.92); NVS 2.63 (2.00-3.45) Two or more psychiatric disorders: VS 1.93 (1.60-2.34); NVS 3.83 (2.72-5.37) <u>Substance use disorders:</u> Alcohol: VS (NS); NVS 0.71 (0.53-0.94) Cocaine: VS 0.62 (0.46-0.83); NVS (NS) Cannabis: NS for both Opiate: VS (NS); NVS 1.67 (1.08-2.60) Amphetamine: NS for both Barbiturate: NS for both Multiple/other: VS 0.80 (0.67-0.98); NVS 1.48 (1.13-1.93)
Kaplan 2007 <sup>30</sup>	Prospective cohort	Assess the risk of mortality from suicide among male Veteran participants in a large population-based health survey	104,026 Veterans; 216,864 non-Veterans	Data from the 1986-94 National Health Interview Survey. People from the 50 states and Washington DC who were not institutionalized. Suicide data from the Multiple Cause of Death file (1986-97) through the NDI.	<u>Veterans vs Non-Veterans</u> Age: 18-44: 25% vs 70% 45-64: 45% vs 20% ≥65: 30% vs 9% Male: 95% vs 38% White: 85% vs 74% Not white: 14% vs 23% At least one psychiatric condition: 1.5% vs 2.0%	Non-Veterans from the same survey	Age, marital status, living arrangement (alone or with others), race, education, employment status, region of residence, place of residence, BMI, number of chronic non-psychiatric medical conditions, number of psychiatric conditions, self-rated health, and activity limitations	Self-report	12 years	Cox proportional hazards model adjusting for demographic characteristics, socioeconomic factors and health	<u>Risk factors for suicide. Adjusted HR (95% CI):</u> Age (years): NS Race – white vs non-white: 3.23 (1.75-5.88) Marital status: NS Living alone (vs with others): NS Education ≥12 years vs <12 years: 2.67 (1.38-5.17) Employment status: NS Region of residence: NS Place of residence – urban/rural: NS Poor self-rated health: NS BMI – overweight vs normal: 0.45 (0.22-0.92) BMI – underweight or obese vs normal: NS Number of chronic non-psychiatric conditions: NS Number of psychiatric conditions: NS Activity limitations vs not limited: 4.44 (1.33-14.80)

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Mahon 2005 <sup>31</sup>	Retrospective case control	Examine risk factors for suicide among regular-duty military personnel	63 suicides and 63 age and gender matched controls drawn from a cohort of 732 deaths among regular-duty Army, Navy, Air Corps, and special forces personnel. Regression done only on 33 firearms deaths and matched controls.	732 deaths of regular-duty military personnel in the Irish Defense Forces between 1970 and 2002	63 suicides; regression done only on 33 firearm suicides that all used military firearms	Suicides were compared with a randomly age-gender matched non-suicide death (excluded deaths that were "open" i.e., accidental deaths, drownings)	Demographics, details of the suicide	Cause of death (suicide outcome) was determined by examination of the proceedings of Courts of Inquiry and medical records. Variables regarding details of the suicide were obtained from military files which include inquest/ autopsy reports, toxicology/forensic reports, and eye-witness/family/ colleague reports.	N/A – retrospective analysis of factors knowing the actual outcome (suicide)	Logistic regression controlling for variables suggested in bivariate analyses and factors that were clinically or occupationally associated with suicide (all listed, but those included are not specifically reported)	3 variables accounted for 84.2% of the variation in the data and 83.3% of the firearm suicides ( $\chi^2(df2)=1.0$ , $p<0.001$ ): Psychiatric illness or history of deliberate self-harm (OR 0.00; 95% CI, 0.00-8.3x10 <sup>33</sup> ), performing morning duty (OR 12.6; 95% CI, 2.78-57.3), and a recent medical downgrading (OR =27,766.31; 95% CI, 0.00-1.17x10 <sup>58</sup> ).
Pettit 2006 <sup>42</sup>	Cross-sectional	Examine the moderating effects of very early onset diagnostic status ( $\leq 13$ years) upon the association between life events and non-fatal suicide attempt	298 patients with suicidality	Two outpatient clinics, a 20-bed inpatient facility and an emergency room, all affiliated with US Army Medical Center	Mean age: 22.22 years 82.2% male 62.8% Caucasian	Those with prior self-reported suicide attempt compared to those without	Negative life events using Life Experiences Survey, Modified Scale for Suicidal Ideation, current and past psychiatric diagnoses by the Diagnostic Interview Schedule, incorporating DSM-III-R criteria, and past suicide attempt	Clinical interview	N/A	Logistic regression – one for each of the mental health variables: very early onset bipolar disorder, very early onset MDD, and very early onset anxiety; controlled for age in all; life events as interaction term	<u>OR (95% CI), in the model with age, negative life events and very early onset bipolar disorder, and the interaction term for very early onset bipolar disorder x negative life events:</u> Age: NS Negative life events: NS  Very early onset bipolar disorder: NS Negative life events x Very early onset bipolar disorder: 0.88 (0.78-0.99) Very early onset bipolar disorder moderates the association between negative life events and suicide attempts – lower levels of negative life events among attempters with no history of very early onset bipolar disorder. Excluding patients with very early onset bipolar disorder, negative life events was marginally significant for predicting suicide attempts: OR 1.30 (95% CI, 1.02-1.65) Neither very early onset bipolar disorder nor very early onset anxiety moderated the association between life stress and suicide attempt.



Author, Year	Study design	Aim of study	Sample size	Data source, sample time frame, location	Population characteristics	Comparison group (if any)	Risk factor(s) measured	Method of measurement of risk factor(s)	Length of follow-up/ observation time	Statistical analysis methods/ Control for confounding	Results
Pfeiffer 2009 <sup>32</sup>	Prospective cohort	Examine whether depressed Veterans with comorbid anxiety had higher risks of suicide deaths	887,889 patients with depression; 1892 suicide deaths	A national database of US Veterans in depression treatment (NARDEP) linked to NDI; April 1, 1999 to September 30, 2004	Age: 18-44 years: 16.1% 45-64 years: 50.1% ≥65 years: 33.8% 91.9% male 76.5% white 22.1% with substance abuse disorder	None	Any anxiety disorder PTSD Anxiety disorder NOS Panic disorder Generalized anxiety disorder Social phobia OCD Any other anxiety disorder Ever prescribed anxiety medication Ever prescribed high dose anxiety medication	Treatment and administrative records, pharmacy database records	5.5 years	Logistic regression analysis; adjusted for gender, age, race, ethnicity, marital status, and presence of a substance use disorder	<u>Predictors of suicide among depressed Veterans. Adjusted OR (95% CI):</u> Any anxiety disorder: 1.07 (0.98-1.18) PTSD: 0.87 (0.77-0.97) Anxiety disorder (not otherwise specified): 1.25 (1.12-1.38) Panic disorder: 1.26 (1.04-1.53) Generalized anxiety disorder: 1.27 (1.09-1.47) Social phobia: 0.59 (0.29-1.18) OCD: 1.10 (0.73-1.67) Any other anxiety disorder: 1.05 (0.85-1.29) Ever prescribed anti-anxiety medication: 1.71 (1.55-1.88) Ever prescribed high dose anti-anxiety medication: 2.26 (1.98-2.57)
Pinder 2011 <sup>33</sup>	Cross-sectional	Assess lifetime prevalence of suicide and self-harm within currently serving and ex-service personnel of the UK Armed Forces, and associations with socio-demographics, service history and mental health	821	Telephone interview, U.K.	Personnel who had previously participated in the King's Centre for Military Health Research military health study (4.7% reported prior suicide attempt) – initial recruitment via mailing, stratified by serving status (regular/reserve) and deployment status (first phase Iraq or not), oversampled for those reporting psychological distress	Self-reported intentional self-harm vs. none	PHQ, Primary Care Post-Traumatic Disorder Screen, 2000 Adult Psychiatric Morbidity Survey questions about suicide	Self-report	N/A	Adjusted OR using STATA with weighted percentages: adjusted for age, gender, marital status, educational status, engagement type, rank at interview, service, length of service, serving status at interview, experience of deployment to Iraq, and number of childhood adversity factors	<u>Adjusted OR (95% CI) for intentional self-harm (adjusted for age, serving status and childhood adversity):</u> PTSD or PHQ diagnosis: 4.65 (1.91-11.33) Any PHQ diagnosis: 4.14 (1.75-9.81) Any depressive syndrome: 3.08 (1.08-8.78) Any anxiety syndrome: NS Alcohol abuse: NS Somatization disorder: 3.65 (1.20-11.03) PTSD: 8.48 (2.73-26.33) <u>Adjusted OR (95% CI) for intentional self-harm (adjusted for age, educational status, engagement type, rank, service, serving status, and childhood adversity):</u> Serving status at interview – left service vs serving: 2.82 (1.08-7.34) Age at interview: 0.94 (0.87-1.00) (p=0.042) (0.04-0.33) for 0-1 factors; 0.19 (0.07-0.52) for 2-3 factors; and NS for 4-5 factors NS: Experience of deployment to Iraq, rank at interview, service (Navy, Army, Royal Air Force), length of service, educational status, and engagement type

Author, Year	Study design	Aim of study	Sample size	Data source, sample time frame, location	Population characteristics	Comparison group (if any)	Risk factor(s) measured	Method of measurement of risk factor(s)	Length of follow-up/ observation time	Statistical analysis methods/ Control for confounding	Results
Roy 2011 <sup>34</sup>	Retrospective case control	Examine whether resilience might be a protective factor in relation to suicidal behavior	20 cases who attempted suicide; and 20 controls who did not attempt suicide (matched on age and Childhood Trauma Questionnaire score)	100 consecutive abstinent substance-dependent patients who completed the Connor-Davidson Resilience Scale, who were seen in the Substance Abuse Treatment Program at the Department of VA New Jersey Health Care System, East Orange Campus. Identified 20 substance abuse patients who had attempted suicide	Met DSM-IV criteria for substance dependence and were abstinent when studied. Excluded those with lifetime history of schizophrenia, other psychosis, or mental retardation.	20 substance abuse patients who had not attempted suicide, matched on age and Childhood Trauma Questionnaire score	Resilience measured by the Connor-Davidson Resilience Scale score	Psychiatric interview conducted by a psychiatrist about socio-demographic variables, substance dependence history, and lifetime history of suicide attempt. Supplemented by collateral information from program staff, medical records, program internist and physicians assistant, and treating mental health professional.	N/A	Matched on age and Childhood Trauma Questionnaire score; t-tests and chi-square	20 patients who had never attempted suicide had significantly higher Connor-Davidson Resilience Scale scores than the 20 age and Childhood Trauma Questionnaire matched patients who had attempted suicide: mean Connor-Davidson Resilience Scale score 63.61 (SD 20.44) vs 47.55 (SD 18.14), p<0.0123.
Seyfried 2011 <sup>35</sup>	Longitudinal	Assess predictors of suicide and means of completion in patients with dementia	294,952	VA National Care Patient Database, NDI, and outpatient VA pharmacy records, from FY 2001- 2005, in VA healthcare settings	Patients aged ≥60 years old who had been diagnosed with dementia in VA healthcare settings between FY 2001 and FY 2005	N/A	Demographics (gender, marital status, race, and age), psychiatric disorders (PTSD, any anxiety disorder, depression, any personality disorder, any substance use disorder [except nicotine dependence], schizophrenia, and bipolar disorder), medical comorbidity, healthcare utilization, psychiatric prescription medication use.	ICD-9 codes and ICD-10 codes, Charlson Comorbidity Index	N/A	Bivariate analyses – chi-square tests of independence, multivariate logistic regression models	<u>Adjusted analyses predicting suicide (adjusted OR, 95% CI):</u> <i>Risk factors:</i> White 1.49 (1.14-1.95) Depression 2.04 (1.45-2.85) Anti-anxiety medication 1.98 (1.48-2.65) Antidepressant medication 2.11 (1.57- 2.84)  <i>Protective factors:</i> inpatient psychiatric hospital stay 2.31 (1.54-3.46) inpatient nursing home stay 0.33 (0.14- 0.75)

Author, Year	Study design	Aim of study	Sample size	Data source, sample time frame, location	Population characteristics	Comparison group (if any)	Risk factor(s) measured	Method of measurement of risk factor(s)	Length of follow-up/ observation time	Statistical analysis methods/ Control for confounding	Results
Thomsen 2011 <sup>36</sup>	Cross-sectional	Examine whether deployment increases risky or self-destructive behavior and whether deployment effects on risky behavior varied depending on history of pre-deployment risky behavior; and to assess whether psychiatric conditions mediated effects of deployment on risky behavior	2116	August 2006-August 2007; Survey of active duty military personnel serving at US Marine Corps installations in Southern California and Arizona	Mean age: 24.1 years (SD 5.3) 92% male Ethnicity/race not reported 58% had been combat deployed	None	Combat deployment, prior engagement in risky behavior, mental health issues	Self-report, anonymous survey	Cross-sectional	Logistic regression; demographic variables, prior high-risk behavior, combat deployment	<u>Results of logistic regression analyses predicting current suicide attempt. Adjusted OR (p-value NS unless specified):</u> Male: 0.58 Older age: 0.97 Higher rank: 0.76 Higher education: 1.23 Navy (vs Marines): 0.79 Single: 0.78 Divorced/Separated/Widowed: 3.90 (p<0.01) Prior behavior: 8.58 (p<0.001) Combat deployment: 0.86 Prior behavior x deployment: 1.68
Tiet 2006 <sup>37</sup>	Cross-sectional	Examine the associations between sexual and physical abuse and recent suicide attempts among men	34,245	VA database July 1997 to September 1997, 150 VA facilities across the US	Patients seeking treatment for substance use disorders, other psychiatric disorders, or both	Those with suicide attempt in past 30 days vs those without.	Demographics (age, education, race, marital status), psychiatric diagnoses (psychotic disorder, depressive disorder, PTSD, anxiety disorder, alcohol abuse/dependence, drug abuse/dependence, personality disorder), suicide attempts over the past 30 days and during lifetime, sexual abuse in the past 30 days and during lifetime, and physical abuse in the past 30 days and during lifetime	ASI administered by trained interviewers	N/A	Bivariate analyses, multivariate logistic regression analyses; adjusted for sexual and physical abuse (lifetime and past 30 days), psychiatric disorders, alcohol/drug abuse, age, marital status	<u>Multivariate logistic regression analysis of suicide attempts in the past 30 days among men seeking treatment for substance use disorders, psychiatric disorders or both (adjusted OR: 95% CI):</u> sexual abuse in past 30 days (2.08; 1.26-3.43), physical abuse in past 30 days (2.38; 1.83-3.10), lifetime sexual abuse before past 30 days (1.33; 1.10-1.61), lifetime physical abuse before past 30 days (NS), psychotic disorder (1.48; 1.28-1.73), depressive disorder (2.38; 2.07-2.74), PTSD (1.37; 1.19-1.57), anxiety disorder (1.45; 1.26-1.67), alcohol abuse/dependence (NS), drug abuse/dependence (NS), personality disorder (1.74; 1.50-2.01), older age (0.97; 0.96-0.98), married (NS)

Author, Year	Study design	Aim of study	Sample size	Data source, sample time frame, location	Population characteristics	Comparison group (if any)	Risk factor(s) measured	Method of measurement of risk factor(s)	Length of follow-up/ observation time	Statistical analysis methods/ Control for confounding	Results
Valenstein 2009 <sup>38</sup>	Longitudinal	Determine higher-risk periods for suicide among VA patients receiving depression treatment	887,859	VA patients receiving antidepressant treatment between April 1, 1999 and September 30, 2004	Mean age: 58.6 years (SD 14.4) 91.9% male 76.5% white; 12.4% black; 2.1% other (Asian, American, Native, Pacific Islander, multiracial); 9.0% unknown race; 4.7% Hispanic	None	Time period (in five sequential 12-week periods following treatment events), age, gender, race, ethnicity, marital status, diagnosis of a substance abuse disorder, PTSD, and service connection	Data from VA's NARDEP. Not specified how data were collected.	60 weeks following their last treatment event of interest, date of death, or end of study (September 30, 2004), whichever came first	Poisson regression model used to fit piecewise exponential models, with generalized estimating equations to allow for correlation within patients when multiple episodes of treatment events were included in the analyses. RRs calculated after adjusting for age, gender, race, ethnicity, marital status, diagnosis of a substance use disorder, PTSD, and service connection.	Time period was significantly associated with suicide following all treatment events ( $P < 0.001$ ). <u>RR (95% CI) for first compared to second 12-week periods:</u> Following psychiatric hospitalizations: 1.9 (1.5-2.4) Following new antidepressant starts: 1.8 (1.5-2.1) Following other antidepressant starts: 1.8 (1.4-2.3) Following dose changes: 1.4 (1.1-1.8) Following "any antidepressant regimen change": 1.8 (1.5-2.1) Following "any treatment event": 1.8 (1.6-2.1)

Author, Year	Study design	Aim of study	Sample size	Data source, sample time frame, location	Population characteristics	Comparison group (if any)	Risk factor(s) measured	Method of measurement of risk factor(s)	Length of follow-up/ observation time	Statistical analysis methods/ Control for confounding	Results
Yerevanian 2007 (Part 2) <sup>40</sup>	Prospective cohort	Examine the association between pharmacotherapy (mood stabilizers and antidepressants) and suicide among individuals diagnosed with bipolar disorder receiving care through the VHA	405	Computerized Patient Record System, January 1, 1994 to December 31, 2002, VA Greater Los Angeles Healthcare System	Patients with pharmacy records of lithium, divalproex, carbamazepine, gabapentin, topiramate, and lamotrigine dispensed from January 1, 1994 to December 31, 2002; who were given a chart diagnosis of bipolar disorder type I or type II, schizoaffective disorder bipolar type, or bipolar disorder not otherwise specified; who received ≥6 months of care for bipolar disorder by an attending psychiatric physician with a chart documentation of inquiry about suicidal behavior by the psychiatrist	N/A	Demographics (gender, age), diagnoses (bipolar I disorder, bipolar II disorder, schizoaffective disorder, bipolar disorder not otherwise specified), pharmacotherapy (mood stabilizer monotherapy, antidepressant monotherapy, mood stabilizer combined with an antidepressant), outcomes (suicide, suicide attempts, hospitalization for suicidal intent)	Assumed DSM-IV diagnostic criteria, "suicidal behavior life chart" to track medications received and occurrence of suicidal behavior events	Followed for a mean of 3 years	Generalized linear regression model, with (log) number of events as dependent measures, medication status as independent variable, and (log) total time observed as an offset variable specifying Poisson error. This method models the rates (events/[time at risk]) as an exponential function of medication status.	<p><u>Comparison of suicidal behavior during mood stabilizer therapy vs mood stabilizer combined with antidepressant:</u> <math>\chi^2=8.71</math>, <math>df=1</math>; <math>p=0.003</math></p> <p><u>Suicidal behavior during mood stabilizer monotherapy compared with antidepressant monotherapy:</u>                      On Lithium: <math>\chi^2=19.14</math>, <math>df=1</math>; <math>p&lt;0.0001</math>                      On Divalproex: <math>\chi^2=14.4</math>, <math>df=1</math>; <math>p=0.0001</math>                      On mood stabilizer monotherapy: <math>\chi^2=29.87</math>, <math>df=1</math>; <math>p&lt;0.0001</math></p> <p><u>Suicidal behavior event rates during antidepressant and/or mood stabilizer therapy in bipolar patients who received all three treatments. Rate (all events/100 PY):</u>                      On mood stabilizer monotherapy: 13.41                      On mood stabilizer + antidepressant: 23.72                      On antidepressant alone: 38.18</p> <p><i>Note: 1 suicide in the mood stabilizer + antidepressant group; none in the others. 5 attempted suicides among the mood stabilizer + antidepressant group; 7 attempted suicides in the antidepressant monotherapy group and none in the mood stabilizer monotherapy group.</i></p>

Author, Year	Study design	Aim of study	Sample size	Data source, sample time frame, location	Population characteristics	Comparison group (if any)	Risk factor(s) measured	Method of measurement of risk factor(s)	Length of follow-up/ observation time	Statistical analysis methods/ Control for confounding	Results
Yerevanian 2007 (Part 3) <sup>39</sup>	Prospective cohort	Examine the association between pharmacotherapy (mood stabilizers and antipsychotics) and suicide among individuals diagnosed with bipolar disorder receiving care through the VHA	405	Computerized Patient Record System, January 1, 1994 to December 31, 2002, VA Greater Los Angeles Healthcare System)	Patients identified with pharmacy records of lithium, divalproex, carbamazepine, gabapentin, topiramate, and lamotrigine dispensed from January 1, 1994 to December 31, 2002; who were given a chart diagnosis of bipolar disorder type I or type II, schizoaffective disorder bipolar type, or bipolar disorder not otherwise specified; who received ≥6 months of care for bipolar disorder by an attending psychiatric physician with a chart documentation of inquiry about suicidal behavior by the psychiatrist	N/A	Demographics (gender, age), diagnoses (bipolar I disorder, bipolar II disorder, schizoaffective disorder, bipolar disorder not otherwise specified), pharmacotherapy (mood stabilizer monotherapy, antipsychotic monotherapy, mood stabilizer combined with an antipsychotic), outcomes (suicide, suicide attempts, hospitalization for suicidal intent)	Assumed DSM-IV diagnostic criteria, "suicidal behavior life chart" to track medications received and occurrence of suicidal behavior events	Followed for a mean of 3 years	Rates of events calculated by medication status over total time observed. Rates were then compared using a generalized linear regression model, with (log) number of events as dependent measures, medication status as independent variable, and (log) total time observed as an offset variable specifying Poisson error. This method models the rates (events/ [time at risk]) as an exponential function of medication status.	Non-lethal suicide event rates were 9.4 times greater ( $\chi^2=28.29$ ; $p<0.0001$ ) during antipsychotic monotherapy and 3.5 times greater during mood stabilizer + antipsychotic therapy ( $\chi^2=15.13$ ; $p=0.0001$ ) than during mood stabilizer monotherapy.
Zivin 2007 <sup>41</sup>	Longitudinal	Report clinical and demographic factors associated with suicide among Veterans diagnosed with depression	807,694	VA's NARDEP linked to VA Medicare Data Merge Initiative and the NDI, April 1, 1999 to September 30, 2004	Patients with a diagnosis of a depressive disorder and who had been prescribed an antidepressant, or patients with two medical visits that resulted in the diagnosis of depressive disorders during the study period	N/A	Demographics (gender, race, ethnicity [Hispanic or not], age, region of treatment location), diagnoses (depression, PTSD, substance abuse), inpatient psychiatric hospitalization, Charlson Comorbidity Index (for physical comorbidities), and service connection	Unclear	N/A	Unadjusted suicide rates; adjusted suicide rates (by age, gender, race, ethnicity, and psychiatric and substance abuse comorbidity status); estimated suicide rate using crude mortality and estimated HRs using Cox proportional hazards regression models; estimated adjusted HRs and 95% CI	<u>Adjusted analyses (adjusted OR, 95% CI):</u> <i>Protective factors include:</i> woman vs man (0.35, 0.26-0.47), black vs white (0.24, 0.19-0.30), Hispanic vs not (0.47, 0.35-0.63), age ≥ 65 vs age 18-44 (0.85, 0.73-0.99), age 45-64 vs age 18-44 (0.74, 0.64-0.84), PTSD diagnosis vs not (0.77, 0.68-0.87), service connection vs not (0.86, 0.77-0.96), Northeast region vs South (0.76, 0.66-0.87), Central region vs South (0.80, 0.71-0.91). Non-significant factors include Charlson score ≥1 vs 0 (0.95, 0.86-1.01), West region vs South region (0.92, 0.81-1.01). <i>Risk factors include:</i> any substance use (1.74, 1.55-1.96), previous inpatient stay for psychiatric disorder in last 12 months (1.92, 1.61-2.28).  When adding interaction terms for PTSD x age ≥65 and PTSD x age 45-64, PTSD is no longer a significant protective variable for suicide. Only other changes with this model: age ≥ 65 no longer significant.

## APPENDIX L. RISK OF BIAS RATINGS FOR PRIMARY STUDIES OF FACTORS TO PREDICT SUICIDAL SELF-DIRECTED VIOLENCE IN MILITARY AND VETERAN POPULATIONS<sup>a</sup>

Study, Year	1. Adequate description of population	2. Non-biased selection	3. Low loss to follow-up/missing data adequately described?	4. Adequate/unbiased risk factor measurement?	5. Adequate/unbiased outcome measurement?	6. Was the sample size adequate (including adequate number of outcome events)?	7. Adequate statistical adjustment	8. Number of required confounders adjusted for in analysis (X of 4)	Overall assessment of potential for bias Low/Unclear/High	External validity
Belik 2009 <sup>18</sup>	Unclear - but previously reported	Yes - CCHS-CFS data	Unclear - no information on missing data	Unclear - face-to-face interview	Unclear - self-report	Yes - N=8441	Yes - lifetime mental disorder diagnosis	1 of 4	Unclear	Canadian armed forces personnel
Belik 2010 <sup>19</sup>	Yes	Yes - CCHS-CFS is a representative sample of active Canadian armed forces personnel; CCHS 1.2 is a nationally representative sample of individuals age ≥15 years	Unclear - no information on missing data	Partially - clinical interview for mental health diagnosis; self-report for alcohol use	Unclear - self-report: asked the following question on survey: have you "attempted suicide or tried to take [your] own life in the past 12 months?"	Yes - N=36,984 civilians, 8441 armed forces personnel	Yes - mental disorders, alcohol dependence	2 of 4	Unclear	Canadian armed forces personnel
Bell 2010 <sup>20</sup>	Yes	1873 identified suicides from data sources: Total Army Injury and Health Outcomes Database, all death files and inpatient hospital data from the Army Individual Patient Data System, and personnel records from Defense Manpower Data Center	Unclear - missing data not reported	Unclear - ICD-9 codes from hospital and Army personnel records	Yes - death records for suicide	Yes - N=1873 cases, 5619 controls	Yes - mental disorder and alcohol disorder	2 of 4	Unclear	US Army soldiers who committed suicide within 120 days of post-military discharge
Brenner 2011 <sup>21</sup>	Yes	Yes - all cases included and random selection for controls with replacement where necessary	Unclear - unknown number of suicides were missed because they were not identified by the VA database	Yes - keyword search of the medical records for identification of risk factors, specifically PTSD, TBI and neurologic disease; described in detail	Yes - similar assessment to risk factors: keyword search plus chart review by licensed clinical psychologist	Yes - N=81 cases, 160 controls	Matched on age and gender, all had mental health diagnosis (PTSD)	1 of 4 (PTSD)	Unclear	US Veterans receiving mental health services
Brenner, 2011 <sup>22</sup>	Yes - Table 1 lists age and gender, and the rates of TBI (all), concussion, and cerebral contusion/intracranial hemorrhage	Yes - identified by ICD-9 codes for diagnosis of TBI and TBI-related diagnoses, excluding epilepsy	Unclear - no information on missing data	Unclear - based on ICD-9 codes, but unknown number of missed cases of TBI due to underdiagnosis	Yes - based on ICD-9 codes	Yes - 105 suicide deaths	Cox proportional hazards survival models for time to suicide; adjusted for psychiatric comorbidities (among other factors)	1 of 4 (any mental health disorder)	Unclear	People who received VA inpatient or outpatient healthcare services
Cox 2011 <sup>23</sup>	Yes - 32.9% of women vs 9% of men did not have rank; therefore considered retired or dependent	Yes - random sample of charts from those admitted with suicidal thoughts or behaviors	Unclear - missing data not reported	Unclear - chart review only, but trained coders assessed reliability	Yes - patients were admitted to a psychiatric unit for suicidal thoughts or behaviors	Yes - N=465 with suicidal thoughts, 191 with suicidal behaviors	Yes - MDD, other psychiatric diagnoses, substance or alcohol abuse	2 of 4	Unclear	Patients admitted to a US army hospital

Study, Year	1. Adequate description of population	2. Non-biased selection	3. Low loss to follow-up/ missing data adequately described?	4. Adequate/ unbiased risk factor measurement?	5. Adequate/ unbiased outcome measurement?	6. Was the sample size adequate (including adequate number of outcome events)?	7. Adequate statistical adjustment	8. Number of required confounders adjusted for in analysis (X of 4)	Overall assessment of potential for bias Low/Unclear/High	External validity
Desai 2005 <sup>24</sup>	Yes	Yes - all patients discharged with one of four diagnoses in a 4-year period	Unclear - missing data not reported	Unsure	Yes - NDI and ICD-9 codes to identify suicide deaths	Yes - N=121,933	Yes	2 of 4 (psychiatric diagnosis, including substance abuse)	Unclear	Psychiatric inpatients from US VA hospitals
Hartl 2005 <sup>14</sup>	Yes - 630 male Veterans with PTSD who consecutively entered the residential rehabilitation program for PTSD at the Palo Alto VA between July 1994 and December 2000	Yes - consecutive admissions	Unsure - missing data not reported, but used information typically collected at the outset of most treatment programs	Unsure - questionnaires at intake, meant to be generalizable to other programs. However, the questionnaires themselves were not described or cited. Did not report how patients' war zone trauma exposure was collected. Treatment-related variables are likely to be most accurate for readmissions to this program, less so for admissions from other programs.	Unsure - self-report; violent behavior and suicide attempts assessed with items from the Northeast Program Evaluation Center Survey	Yes - N=630, 8.1% attempted suicide (n=50)	Yes - chi square only, but given that they have already controlled for psychiatric diagnosis by including only patients with PTSD who were entering substance abuse treatment, this is adequate	3 of 4	Unclear	Veterans diagnosed with PTSD entering residential rehabilitation program for substance abuse
Ilggen 2007 <sup>28</sup>	Yes	Yes - assessed all patients at entry into VA substance use disorders program, no exclusion criteria used	No - enrolled only those who completed follow-up (n=8807) from 13,870 total enrolled	Yes - used ASI, standardized measure. Trained all providers on administration and then required all patients to complete at intake.	Unsure - self-reported suicide attempt in past 30 days	Yes - N=8807	Yes - was entirely a substance use disorder population; assessed 35 risk factors and included 5 in the final model	4 of 4 (details of substance use, psychiatric diagnoses, suicidal ideation, prior suicide attempts - last 3 felt to be proxies for each other and therefore combined into one variable)	Unclear	Veterans enrolled in substance use disorder programs
Ilggen 2009 <sup>27</sup>	Unclear - limited characteristics reported (gender, race, substance abuse, PTSD, service connection, inpatient psychiatric stay in past 12 months), age not reported	Unclear - used data from a specified time period and had inclusion criteria, but not clear if all patient data were reviewed for eligibility	Unsure - does not report how many of the final analytic cohorts were missing variables	Unsure - chart review (possible inaccuracies in race; 9% unknown race, for example), assume most risk factors determined by ICD-9 code	Yes - suicide outcome was confirmed by NDI and they were careful to query even those patients without a death date but who did not receive VA services in following year	Yes - N=1275 suicide deaths	Yes - substance abuse and mental health	2 of 4 (assessed depressed population only; additional factors: PTSD, psychiatric admission, substance use disorder. No report of suicidal ideation or prior attempts.)	Unclear	US VA patients treated for depression



Study, Year	1. Adequate description of population	2. Non-biased selection	3. Low loss to follow-up/ missing data adequately described?	4. Adequate/ unbiased risk factor measurement?	5. Adequate/ unbiased outcome measurement?	6. Was the sample size adequate (including adequate number of outcome events)?	7. Adequate statistical adjustment	8. Number of required confounders adjusted for in analysis (X of 4)	Overall assessment of potential for bias Low/Unclear/High	External validity
Ilggen 2010 <sup>25</sup>	Yes	Yes - database; all patients in a specified time period	Unsure - no information on missing data	Unsure - all risk factors determined by ICD-9 code; they were careful to design the study such that risk factors were assessed prior to the outcome	Yes - NDI	Yes - N=7684 suicide deaths	Yes - proportional hazard regression, adjusted for substance abuse and mental health	2 of 4	Unclear	Veterans seeking services tend to have poorer general physical and mental health functioning than the US population. Rank, socioeconomic status and time since military discharge may be important and were not examined.
Ilggen 2010 <sup>29</sup>	Yes	Yes - LHSV was mailed to a national random sample of Veteran enrollees; RR not reported	Unsure - no information on missing data	Unsure - medical records review; used ICD-9 diagnostic codes for psychiatric diagnoses and substance use disorders; self-report for pain outcomes and SF-36	Yes - NDI data	Yes - overall sample size N=260,254	Yes - substance abuse and mental health	2 of 4 (all had substance use disorder)	Unclear	US Veterans
Ilggen 2010 <sup>26</sup>	Yes	Yes - LHSV was mailed to a national random sample of Veteran enrollees; RR not reported	Unsure - no information on missing data	Unsure - chart review only; ICD-9 for psychiatric and substance use disorder diagnoses	Yes - NDI data	Yes - N=854	Yes - substance abuse and mental health	2 of 4	Unclear	US Veterans with substance use disorder
Kaplan 2007 <sup>30</sup>	Yes	Yes - used all data from a population-based health survey	Unsure - missing data not reported; unclear if missing outcome, demographic, or risk factor data on some of the population	Yes - number of psychiatric conditions ascertained based on ICD-9 codes	Yes - objective measures used (NDI, ICD-9 codes)	Yes - N=320,000; 104,026 Veterans; 197 suicide deaths in Veterans	Yes - had at least one psychiatric condition (and other factors)	1 of 4 (number of psychiatric conditions)	Unclear	Veterans, males only (too few women to include in analysis); various service areas
Mahon 2005 <sup>31</sup>	No - some characteristics reported, but not demographics	Yes - reviewed all causes of death for all personnel active during the study period	Partly - excluded open-verdict deaths (drowning, train accidents, and single-vehicle road traffic accidents; 5.2% of deaths were drowning and 18.7% were road traffic accidents)	Unsure - assume data (e.g. psychiatric diagnosis) collected from military files but not described	Unsure - military files and proceedings of Courts of Inquiry were reviewed by the investigators to determine cause of death	Yes - N=63 suicide deaths (overall sample 732 deaths)	Yes - bivariate analysis; confounders included psychiatric diagnosis, history of deliberate self-harm, and recent psychiatric assessment	2 of 4 (psychiatric diagnosis, past history of deliberate self-harm)	Unclear	Irish Defense Forces

Study, Year	1. Adequate description of population	2. Non-biased selection	3. Low loss to follow-up/ missing data adequately described?	4. Adequate/ unbiased risk factor measurement?	5. Adequate/ unbiased outcome measurement?	6. Was the sample size adequate (including adequate number of outcome events)?	7. Adequate statistical adjustment	8. Number of required confounders adjusted for in analysis (X of 4)	Overall assessment of potential for bias Low/Unclear/High	External validity
Pettit 2006 <sup>32</sup>	Yes	Unclear - no data on consecutive recruitment	Unsure - design of study ensured that all data were complete	Unclear - licensed professionals did assessments using standard measures. No information on whether they were blinded to past suicide attempts.	Unsure - self-report suicide attempts	Yes - 41.8% reported a non-fatal suicide attempt prior to entry in the program	Yes - all patients had suicidality. They evaluated specific mental health diagnoses in the setting of suicidality.	2 of 4 (suicidality and mental health diagnosis)	Unclear	Moderate - these were patients at a US Army Medical Center, so could include spouses and dependents of military personnel
Pfeiffer 2009 <sup>32</sup>	Yes	Yes	Unsure - no information on missing data is reported	Unsure - comorbid anxiety disorders and substance use disorders obtained from clinical and administrative records, but unclear about content or blinding of raters	Yes - suicide mortality determined from cause of death contained in NDI	Yes - N=1892 suicide deaths	Yes	2 of 4 (anxiety disorders and substance use disorders)	Unclear	US Veterans with depression
Pinder 2011 <sup>33</sup>	Yes	Yes	Unsure - 24% (262/1083) were not surveyed due to declining to participate (10%), could not be traced (15%) or unavailable for interview (2%). Noted no evidence of response bias in response to health, but did not provide details of how this was determined.	Unsure - self-report via questionnaire and clinical interview	Unclear - self-reported self-harm	Yes - 80/821 had a history of a suicide attempt	No - univariable analysis of factors including mental health diagnosis and substance abuse, but, did not simultaneously adjust for required confounders.	1 of 4 (psychological distress – childhood adversity)	High	UK armed forces personnel, 70% of whom reported psychological distress as defined by a score of 4 or more on the 12-item general health questionnaire
Roy 2011 <sup>34</sup>	Yes	Unsure if 53 who had never completed the Childhood Trauma Questionnaire were systematically different from those that had	Yes - only included those who completed the Childhood Trauma Questionnaire	Unsure - self-report supplemented by collateral information from clinicians and medical records	Unsure - self-reported history of suicide attempt via psychiatric interview by study psychiatrist; supplemented by collateral information from clinicians and medical records	No - although 41 patients had attempted suicide, only possible to match 20 cases with 20 controls for analysis	Unsure - assessed resilience in population of abstinent substance abuse patients matched for childhood trauma; but did not adjust further	1 of 4 (all had substance abuse)	High	Abstinent substance abuse patients who were seen in the Substance Abuse Treatment Program at the Department of VA in New Jersey and had attempted suicide

Study, Year	1. Adequate description of population	2. Non-biased selection	3. Low loss to follow-up/missing data adequately described?	4. Adequate/unbiased risk factor measurement?	5. Adequate/unbiased outcome measurement?	6. Was the sample size adequate (including adequate number of outcome events)?	7. Adequate statistical adjustment	8. Number of required confounders adjusted for in analysis (X of 4)	Overall assessment of potential for bias Low/Unclear/High	External validity
Seyfried 2011 <sup>35</sup>	Yes - age >60 years with dementia identified by ICD-9	Yes - all patients diagnosed with dementia between FY 2001-05 identified in the VA National Care Patient Database; dementia diagnosis identified by ICD-9	Unsure - not reported. 294,952 patients; 241 suicide deaths. No description of how many people were excluded from the overall eligible sample.	Yes - medical records for demographics, ICD-9 codes for diagnosis of dementia, psychiatric and medical comorbidities	Yes - suicide deaths identified by NDI and ICD-10 codes	Yes - 241 suicide deaths in cohort of 294,952 patients with dementia	Yes - controlled for psychiatric comorbidities, age, sex, race, marital status, medical comorbidities, healthcare utilization and medication use	1 of 4 (psychiatric illness)	Unclear	Veterans with dementia who are ≥60 years old
Thomsen 2011 <sup>36</sup>	Yes	No - attendance at survey recruiting sessions was based on commander referral and availability within training schedule	Unsure - included only those who provided data on their deployment and answered at least 7 or 8 questions on risky behavior. Missing data from 19%; did not report whether missing data differed between groups.	Partly - risky behavior was self-reported via an anonymous written survey. Combat deployment status was determined by record of combat pay (objective).	Unsure - outcome was risky behavior, including attempted suicide; determined by self-report on an anonymous survey	Yes - 7% of sample reported a suicide attempt (148/2116)	Yes	2 of 4 (prior self-harm or suicide attempt, any mental health diagnosis)	Unclear	US military personnel; active duty, mean age 24 years, 92% male
Tiet 2006 <sup>37</sup>	Yes	Yes	Yes - regression analysis included data from 97% of males (32,271/33,236)	Partly - Sexual and physical abuse: Unclear due to use of face-to-face interview, but with a validated questionnaire (ASI). Psychiatric diagnoses: Yes, accessed nationwide VA database to obtain diagnoses made by experienced clinicians during usual care.	Unsure - self-reported suicide attempt in the past 30 days	Yes - overall 33,236 men; 1120 attempted suicide in past 30 days	Yes	2 of 4 (mental health diagnosis, substance abuse)	Unclear	US Veterans seeking treatment for psychiatric disorders; 99% had substance use disorder; mean age 47 years; main findings based on data from males (too few females to include in analysis)
Valenstein 2009 <sup>38</sup>	Yes	Yes - all patients in the database receiving an antidepressant during the study timeframe	Unsure - no information on missing data	Yes - ICD-9 codes for depression and substance abuse disorder from the registry	Yes - used NDI data and did a sensitivity analysis in which deaths of undetermined intent were considered suicides	Yes - overall sample size over 887,000; 1346 suicides	Yes	2 of 4 (all had depression; adjusted for substance abuse disorder and PTSD)	Unclear	US Veterans receiving treatment for depression; mean age 59 years, 92% male

Study, Year	1. Adequate description of population	2. Non-biased selection	3. Low loss to follow-up/missing data adequately described?	4. Adequate/unbiased risk factor measurement?	5. Adequate/unbiased outcome measurement?	6. Was the sample size adequate (including adequate number of outcome events)?	7. Adequate statistical adjustment	8. Number of required confounders adjusted for in analysis (X of 4)	Overall assessment of potential for bias Low/Unclear/High	External validity
Yerevanian 2007 (Part 2) <sup>40</sup>	Yes - identified all patients getting any prescription for lithium, divalproex, carbamazepine, gabapentin, topiramate and lamotrigine during study period; identified subjects then had to have chart diagnosis of bipolar disorder and ≥6 months of clinical care for bipolar disorder and chart documentation of inquiry about suicidal behavior by the psychiatrist	Yes - non-biased selection within the group that was defined as the population of interest	Unclear - completeness of data not described	No - all diagnoses based on chart review; medications from pharmacy data. Patients were not randomly assigned to medications and there was no accounting for severity of illness, provider preference, etc. in the analysis.	No - chart review of psychiatrist documentation about suicidal behavior	Unsure - N=405	No - see notes under #4	1 of 4 (since all patients were bipolar the study essentially accounted for the mental health diagnosis and could assess other risk factors within this population)	High	US Veterans with bipolar disorder in Southern California
Yerevanian 2007 (Part 3) <sup>39</sup>	Yes - identified all patients getting any prescription for lithium, divalproex, carbamazepine, gabapentin, topiramate and lamotrigine during study period; identified subjects then had to have chart diagnosis of bipolar disorder and ≥6 months of clinical care for bipolar disorder and chart documentation of inquiry about suicidal behavior by the psychiatrist	Yes - non-biased selection within the group that was defined as the population of interest	Unclear - completeness of data not described	No - all diagnoses based on chart review; medications from pharmacy data. Patients were not randomly assigned to medications and there was no accounting for severity of illness, provider preference, etc. in the analysis.	No - chart review of psychiatrist documentation about suicidal behavior	Unsure - N=405	No - see notes under #4	1 of 4 (since all patients were bipolar the study essentially accounted for the mental health diagnosis and could assess other risk factors within this population)	High	US Veterans with bipolar disorder in Southern California

Study, Year	1. Adequate description of population	2. Non-biased selection	3. Low loss to follow-up/missing data adequately described?	4. Adequate/unbiased risk factor measurement?	5. Adequate/unbiased outcome measurement?	6. Was the sample size adequate (including adequate number of outcome events)?	7. Adequate statistical adjustment	8. Number of required confounders adjusted for in analysis (X of 4)	Overall assessment of potential for bias Low/Unclear/High	External validity
Zivin 2007 <sup>41</sup>	Yes - data from the VA's NARDEP database. FY 1997 forward; linked to VA Medicare Data and NDI.	Yes - all patients with a diagnosis of depression and an antidepressant prescription, or had two medical visits with diagnosis of depressive disorders during the study period	Unsure - reported that patients with missing data for key covariates were excluded from all analyses, but details only provided for 9% excluded due to missing race data. 1,500,000 starting; with 807,694 satisfying inclusion/exclusion criteria.	Unsure - information on substance abuse diagnosis, diagnosis of PTSD, and prior VA psychiatric hospitalization obtained from the VA's NARDEP database, but details of coding process and blinding of raters was not described. Race data is excluded from analyses because it was unreliably documented.	Yes - suicides identified from NDI database based on ICD-10 codes, compiled from death certificates	Yes - N=807,694	Yes - present adjusted HR with PTSD x age interaction	3 of 4 (substance abuse, history of PTSD, inpatient psychiatric stay)	Unclear	Individuals receiving treatment for depression in the US VA health system

<sup>a</sup> Risk of Bias tool modified from Hayden et al. 2006 and Harris et al. 2001.<sup>9, 10</sup>

## APPENDIX M. PEER REVIEW COMMENTS AND AUTHOR RESPONSES

<i>Reviewer</i>	<i>Comment</i>	<i>Response</i>
<b>Question 1. Are the objectives, scope, and methods for this review clearly described?</b>		
2	The concerns addressed in answers 2 and 3 could, perhaps, have been addressed with a more complete discussion of objectives, scope, and methods.	We have revised and expanded the description of scope and methods section to provide a more detailed explanation of the EBPWG requests.
2	Moreover, the text does not describe how issues of statistical power of the studies reported was addressed.	Statistical power for studies of predictive tools and variables is included in the quality (risk of bias) assessment. In this report, we use the following question in our quality (risk of bias) assessment for each study: “Was the sample size adequate (including adequate number of outcome events)?” was part of our quality (risk of bias) assessment for each study – see Appendix K. We have also added additional detail in the Methods section to make this clearer.
2	Nor does it address the potential problems and pitfalls in the identification of suicide attempts as outcomes.	We briefly addressed the limitations of suicide attempts as outcomes in that section of results, but have added identification of suicide attempts to the Limitations section of the report as well, to further emphasize that issue.
3	Within the review it is stated that key questions 3 and 4 were considered but not addressed because of the adequate volume of evidence identified for the first two questions; however, based on the outcomes (limited recommendations) I am not sure I concur.	We established the scope of this report with the EBPWG. Because non-VA literature is less directly applicable to the VA and DOD populations than literature that reports on data from Veteran and military populations, those studies constitute a weaker body of evidence, given the focus of this review. Along with the EBPWG, we agreed that a detailed look at the strongest body of evidence would be most helpful and that a summary of prior systematic reviews for non-VA populations would suffice. Therefore, we have removed reference to questions 3 and 4 (non-Veteran and non-military populations) from the report since it was confusing to readers.
6	For the most part, these are described well. I was confused by the Table of contents listing 4 key questions, but only 2 of them appearing in the Executive Summary. I think you need to explain in the Executive Summary why you did not address KQs 3 and 4. You may want to explicate further what you mean by finding a sufficient volume of evidence to not do KQ 3 and 4	See above.
<b>Question 2. Is there any indication of bias in our synthesis of the evidence?</b>		
2	The reasons provided in the draft document for not addressing questions 3 and 4 do not make sense. Ignoring these questions appears to reflect some unspecified goals.	See above.

<i>Reviewer</i>	<i>Comment</i>	<i>Response</i>
7	Unsure about why some questions were not addressed	See above.
<b>Question 3. Are there any <u>published</u> or <u>unpublished</u> studies that we may have overlooked?</b>		
1	The AJP March 2012 issue on suicide- a study by Bossarte on attempters might be useful.	We agree that this issue provides potentially valuable information on suicide among Veteran and military populations; however the publication date puts it out of the scope of this systematic review. While not identified systematically nor quality rated, it cannot be included in this report. However, we reviewed the Bossarte et al. study informally: They assessed age, gender, race, mental health status and social/emotional support as risk factors for self-reported suicide attempts on the BFSS. A report of depression, anxiety or PTSD carried an adjusted OR of 21.7 (CI 5.6-84.3); no other factors were significant. Even if included, this study would not add significantly to or change the conclusions of our current report.
2	The rationale for starting the literature review in 2005 is not clearly defined. Basing it on the Mann review does not make sense because that review does not address assessment instruments or risk factors. Basing it on the Gaynes review does not make sense because that publication reviewed relevant literature only until 2002.	The Mann review does review assessment tools. We have clarified the scope and this decision as being based on EBPWG request for the strongest and most directly applicable recent literature on Veterans and members of the military (given the existing literature on civilian populations through such reports as Mann, Gaynes, NICE 2011, Brown, and Goldston). Additionally, we have further summarized the information obtained from other, similar systematic reviews throughout the report to present a more comprehensive review of the literature.
2	It may be useful to include information from merged data on Veterans utilizing VHA services and the NDA, or from VA records on suicide attempts.	Per follow-up discussions with our stakeholder group, we will not include these unpublished data in this report, but the CPG may choose to make use of such raw data as appropriate.
3	Would highly consider adding: information and discussion regarding warning signs (Risk factors are very helpful in terms of understanding behaviors at a population-based level. The field is moving towards warning signs [individualized thoughts/behaviors] that precipitate SDV	We have added a discussion of warning signs in the Future Directions section.
3	Would consider adding non-Veteran/military data.	We have clarified the scope and this decision was based on EBPWG request for recent literature on Veterans and members of the military (given the existing literature on civilian populations through such reports as Mann, Gaynes, NICE 2011, Brown, and Goldston). Additionally, we have further summarized the information obtained from other, similar systematic reviews throughout the report to present a more comprehensive review of the literature.
4	Helpful information might exist in the work of the VA National Center for Patient Safety, which is not included in this report (for obvious reasons). It might be useful to point this out and refer readers to NCPS	Per follow-up discussions with our stakeholder group, we will not include such data in this report, but the CPG may choose to make use of such raw data as appropriate.

<i>Reviewer</i>	<i>Comment</i>	<i>Response</i>
6	I was slightly surprised that you did not find manuscripts linking Patient Health Questionnaire (PHQ) item scores and suicide behavior or ideation. The PHQ-9 <sup>th</sup> item specifically asks about suicidal ideation. A lot of studies have been done using the PHQ in recently years--you may want to consider do some additional very focused search for manuscripts written about the PHQ and possible suicide-related outcomes.	We did not find any articles evaluating the PHQ-9 that met our inclusion criteria. We have added a discussion of the PHQ-9 and recent literature on the PHQ-9 with regard to suicidality to the Recommendations for Future Research section of this report.
7	The rationale for starting the literature review in 2005 does not make sense.	We have clarified the scope and this decision was based on EBPWG request for recent literature on Veterans and members of the military (given the existing literature on civilian populations through such reports as Mann, Gaynes, NICE 2011, Brown, and Goldston). Additionally, we have further summarized the information obtained from other, similar systematic reviews throughout the report to present a more comprehensive review of the literature.
7	I think there are unpublished VA reports that could have been solicited.	Per follow-up discussions with our stakeholder group, we will not include these unpublished data in this report, and the CPG may choose to make use of such raw data as appropriate.
<b>Question 4. Please write additional suggestions or comments below. If applicable, please indicate the page and line numbers from the draft report.</b>		
1	In discussing mental health diagnosis as a potential risk factor, it might be helpful to differentiate clinician-generated MH diagnosis versus those from administrative or existing data- as getting a diagnosis in the chart might indicate treatment engagement	We have added this point to the limitations section.
1	Some of the NDI studies involving national VA databases included VA users, who may not all be Veterans (i.e. some non-Veterans received care at VA facilities). It would be important to note this distinction.	While this may be true in some studies, we anticipate that there are low numbers of non-Veterans included in the VA databases and it may not be possible to identify them individually. Additionally, these people are still members of the Veteran community, which is a population of interest in these studies.
3	Previous section and include citations:  Throughout document would change “Completed Suicide” which sounds like a positive event to “Death by Suicide”	We have now cited both Crosby and Brenner articles on the topic, and clarified terminology throughout, including removal of the term “completed” throughout the entire report. However, we use terms (e.g., suicide attempt) as they were reported in the primary studies in order to provide accurate information from these studies.



<i>Reviewer</i>	<i>Comment</i>	<i>Response</i>
3	Evidence Report – Page 1, some of citations at bottom of page (e.g., are non military/VA sources) this is not clear from reading the text.	We acknowledge that the introduction to this report cites some studies that are not from military or Veteran populations. This section is meant to explain that there are factors derived from military experience that have reasonable likelihood of contributing to increased suicide risk. We have added a citation for TBI that includes Veteran population (Brenner, 2011).
3	Figure 1 and 2 – Known risk factors don’t always lead to distal health outcomes (at least directly) – this is where adding warning signs may be helpful	We have added wording to the Future Research section to acknowledge that warning signs may signify a more immediate state of risk than traditional risk factors which reflect a state of overall heightened risk.
3	Systematic Reviews – page 12 – it may be helpful to explain how or why using chart data (PAI scores) that were entered by the patient before the attempt would be biased?	In this section, we specifically describe the risk of bias due to lack of assessor blinding as related to chart review methods for assessment of suicide attempts. This outcome is potentially influenced by lack of assessor blinding because of it is not as objective or clearly defined as a test score that is included in a patient’s chart. We agree that chart review along for determination of a previously collected assessment tool score would carry a low risk of bias for that outcome.
3	Summary and Discussion – Page 24 – it is not clear that the limitations of the Hendin study are sufficiently highlighted (Citation 10)	We have added a statement describing the risk of bias for this study.
3	Summary and Discussion – Page 24 – is the ASI still nationally implemented? – it was my understanding that it was replaced	We have corrected this information throughout the report.
3	Summary and Discussion – Page 24 – would be important to clarify that the PAI study was only with veterans who had TBIs.	We have added this information.
3	Summary and Discussion – Page 25 – would be helpful to have citations in attempt and suicide paragraphs.	We have added citations to the Summary and Discussion section.
4	I don’t have much to add. I think the synthesis is very timely since many clinicians and administrators continue to search for an instrument or set of variables to predict suicide in an individual patient. We know (or think we know) that some interventions are useful for the entire population but still struggle with prediction in individual cases.	Noted.
5	The executive summary has a few typos: p3, line 28 information about specificity is missing; p4. line 9 the name of the instrument being discussed is missing;	We have made these corrections.

<i>Reviewer</i>	<i>Comment</i>	<i>Response</i>
5	p5. line 21 (and elsewhere in the article) the term “Religious Terror” is very confusing – what does it mean?	The term “religious terror” comes directly from the article that assessed this risk factor (Belik 2009). It is the variable name associated with the question: “Have you ever lived as a civilian in a place where there was ongoing terror of civilians for political, ethnic, religious, or other reasons?” We have clarified this in the text and table.
6	I think you need to confirm your nomenclature matches new national VA standards on nomenclature related to suicide behaviors. This nomenclature should be acknowledged early and clearly—a table may help. The document currently does not use the nomenclature consistently.	We have now cited both Crosby and Brenner articles on the topic, and clarified terminology throughout, including removal of the term “completed” throughout the entire report. However, we use terms (e.g., suicide attempt) as they were reported in the primary studies in order to provide accurate information from these studies.
6	Related to above, it is unclear to me if suicidal ideation is considered an outcome you looked at—what behaviors were and weren’t included?	See above; we have clarified terminology related to outcomes and state that suicidal self-directed violence, but not suicidal ideation, outcomes were included in this report.
6	Since you did not include studies that were included in the prior Mann review, it would be important and helpful to know (briefly) what the findings were from that review and compare and contrast them—did we learn anything new and what did we learn?	We have added a more comprehensive summary from this Mann report as well as from the Gaynes and NICE 2011 Self-Harm reports.
6	You should briefly define reclassification analysis.	We have done this in the Summary and Discussion under KQ#1.
6	In the descriptions in the text of individual studies, I would like to know just a bit more about the design/structure of the study, in particular overall design (e.g. prospective cohort) and how long patients were followed. At the same time, in the Executive Summary I think you have more detail on the specific studies than you need.	Thank you. We have taken this comment into account in our edits of the main report and also the Executive Summary
6	In the Executive Summary, I would include the names of the actual measures, not just the abbreviations in the subsections describing studies that used those measures.	We have made this change.
6	On page 2 of the main document, you say that available evidence suggests that only 4% of people identified as high risk in primary care are truly at risk...--you reference the Gaynes study. To my recollection this 4% figure is the result of an estimate using a best case scenario—you may want to review and restate.	We have provided additional information on the estimates from the Gaynes article; included these because they demonstrate the difficulties with developing assessment tools for rare outcomes.

<i>Reviewer</i>	<i>Comment</i>	<i>Response</i>
6	I think your analytic models are overly detailed (e.g. intake form, specific types of pharmacotherapy or psychotherapy). For me these detract a bit from the overall models and flow and don't add much	We have condensed these into one overall model, and have kept the amount of detail to be consistent with the Suicide Prevention Interventions report.
6	For KQ2 you write that 2 studies were of limited quality—but which two?—you report that 3 of the studies had methodological flaws with high risk of bias	4 of the 26 studies identified for KQ2 had high risk of bias and were cited and not reviewed further.
6	In your recommendations (and perhaps other places earlier) I would suggest you address need for briefer screens (or comment on how long/brief the screens are you recommend for further testing.	We have made this recommendation throughout the report.
<b>Question 5. Are there any clinical performance measures, programs, quality improvement measures, patient care services, or conferences that will be directly affected by this report? If so, please provide detail.</b>		
2	No. In the absence of a review of instruments that are promising on the basis of studies in the civilian population, the report has limited utility. It should not be used to guide clinical performance measures, programs, quality improvement measures, patient care services, or conferences.	We have updated the report to include a more in depth summary of existing assessment literature on civilian populations from the Mann, Gaynes, NICE 2011, Brown, and Goldston reports.
3	Would think this would impact current practices.	Noted.
4	Suicide prevention is quite prominent across many programs in VA and DoD.	Noted.
5	Indirectly, we will continue to educate stakeholders on the lack of data to support the use of specific risk assessment instruments.	Noted.
6	VA Office of Mental Health—Suicide Prevention VISN 19 MIRECC Canandaigua Center of Excellence	Noted.
<b>Question 6. Please provide any recommendations on how this report can be revised to more directly address or assist implementation needs.</b>		
1	It would be helpful for the field to know what are the best available algorithms of suicide risk, and perhaps develop a risk model for clinicians to use to identify patients in their panel at highest risk ) (e.g. through the PACT COMPASS).	We agree that this is an important goal.

<i>Reviewer</i>	<i>Comment</i>	<i>Response</i>
1	In addition, the VA has rolled out the PHQ-9 which includes a question on suicidal ideation- some additional research on its utility in predicting suicide would be helpful.	We have updated the assessment section to include information on the PHQ-9, though we did not find any studies on this assessment tool that met inclusion criteria. We included PHQ-9 in the Discussion.
2	Address question 3	We have updated the report to include a more in depth summary of existing assessment literature on civilian populations from the Mann, Gaynes, NICE 2011, Brown, and Goldston reports.
3	Recommendations re: if and how findings should be incorporated in current practices (e.g., intake)	Recommendations are beyond the scope of this report and will be addressed by the EBPWG.
4	There is nothing here to implement.	Noted.
5	The ASI is no longer routinely used in VA substance abuse settings; the report also seems to discuss the importance of use in primary care for some but not all of the instruments. That would be useful to address as a separate section	We have made this correction re: the ASI. We also provide an expanded discussion of screening and assessment tools that could most easily be applied in primary care settings.
7	Address question 3	We have updated the report to include a more in depth summary of existing assessment literature on civilian populations from the Mann, Gaynes, NICE 2011, Brown, and Goldston reports.
<b>Question 7. Please provide us with contact details of any additional individuals/stakeholders who should be made aware of this report.</b>		
1	Jan Kemp and Toni Zeiss- OMHS Ira Katz and Mary Schohn- OMHO Gordon Schectman and Rick Stark- Primary Care/ PACT	Noted. We will disseminate the report accordingly.
3	Mark Ilgen	Noted. We will disseminate the report accordingly.
4	Office of Research and Development – to help press the need for more research	Noted. We will disseminate the report accordingly.
5	Quality Managers	Noted. We will disseminate the report accordingly.
6	Jan Kemp, Ira Katz, Robert Bossarte	Noted. We will disseminate the report accordingly.

## APPENDIX N. ABBREVIATIONS

<b>Abbreviation</b>	<b>Term</b>
ASI	Addiction Severity Index
ASQ	Affective States Questionnaire
BDI	Beck Depression Inventory
CCHS-CFS	Canadian Community Health Survey Cycle 1.2 - Canadian Forces Supplement
CI	Confidence interval
CIDI	Composite International Diagnostic Interview
DoD	Department of Defense
DSM	Diagnostic and Statistical Manual of Mental Disorders
EBPWG	Evidence Based Practice Working Group
EMR	Electronic medical record
FY	Fiscal year
HR	Hazard ratio
ICD	International Classification of Diseases
IPS	Interpersonal Psychological Survey
LHSV	Large Health Survey of Veterans
MCS	Mental Component Summary
MDD	Major Depressive Disorder
N/A	Not applicable
NARDEP	National Registry for Depression
NDI	National Death Index
NICE	National Institute for Health and Clinical Excellence
NS	Not significant
OCD	Obsessive-compulsive disorder
OEF	Operation Enduring Freedom
OIF	Operation Iraqi Freedom
OR	Odds ratio
PAI	Personality Assessment Inventory
PHQ	Patient Health Questionnaire
PTSD	Post-traumatic stress disorder
PY	Person-year
RR	Relative risk
SD	Standard deviation
SPI	Suicide Potential Index
TBI	Traumatic brain injury
UK	United Kingdom
US	United States
VA	Veterans Affairs
VAMC	Veterans Affairs Medical Center
VHA	Veterans Health Administration
vs	Versus

## APPENDIX O. EXCLUDED STUDIES

The following full-text publications were considered for inclusion but failed to meet the criteria for this report.

Exclusion codes:

- 1 = non-English language
- 2 = ineligible country
- 3 = ineligible outcome
- 4 = did not evaluate risk factors or assessments
- 5 = ineligible publication type
- 6 = ineligible systematic review due to limitations in quality
- 7 = ineligible nonsystematic regulatory agency analysis
- 8 = did not account for major potential confounders
- 9 = primary articles about risk, not a Veteran or military population

Excluded Trials	Exclusion Code
1 Abe K, Mertz KJ, Powell KE, Hanzlick RL. Characteristics of black and white suicide decedents in Fulton County, Georgia, 1988-2002. <i>Am J Public Health</i> . 2006 Oct;96(10):1794-8.	9
2 Acharya N, Rosen AS, Polzer JP, et al. Duloxetine: meta-analyses of suicidal behaviors and ideation in clinical trials for major depressive disorder. [erratum appears in <i>J Clin Psychopharmacol</i> 27 (1): 57]. <i>J Clin Psychopharmacol</i> . 2006 Dec;26(6):587-94.	6
3 Afifi TO, MacMillan H, Cox BJ, Asmundson GJ, Stein MB, Sareen J. Mental health correlates of intimate partner violence in marital relationships in a nationally representative sample of males and females. <i>Journal of Interpersonal Violence</i> . 2009 Aug;24(8):1398-417.	9
4 Ahmadian M, Fata L, Asgharnejhad A, Malakooti K. A comparison of the early maladaptive schemas of suicidal and non-suicidal depressed patients with non-clinical sample. <i>Advances in Cognitive Science</i> . 2008 Win;10(4; 40):98.	1
5 Ahs AM, Westerling R. Mortality in relation to employment status during different levels of unemployment. <i>Scand J Public Health</i> . 2006;34(2):159-67.	2
6 Akdeniz F, Karadag F. Does menstrual cycle affect mood disorders? <i>Turk Psikiyatri Dergisi</i> . 2006;17(4):296-304.	6
7 Aksoy-Poyraz C, Ozdemir A, Ozmen M, Arikan K, Ozkara C. Electroconvulsive therapy for bipolar depressive and mixed episode with high suicide risk after epilepsy surgery. <i>Epilepsy &amp; Behavior</i> . 2008 Nov;13(4):707-9.	2
8 Alexander MJ, Haugland G, Ashenden P, Knight E, Brown I. Coping with thoughts of suicide: techniques used by consumers of mental health services. <i>Psychiatr Serv</i> . 2009 Sep;60(9):1214-21.	4
9 Allen JP, Cross G, Swanner J. Suicide in the Army: a review of current information. <i>Mil Med</i> . 2005 Jul;170(7):580-4.	5
10 Allmer C, Ventegodt S, Kandel I, Merrick J. Positive effects, side effects and adverse events of clinical holistic medicine. A review of Gerda Boyesen's non-pharmaceutical mind-body medicine (biodynamic body-psychotherapy) at two centres in United Kingdom and Germany. <i>International Journal of Adolescent Medicine and Health</i> . 2009 Jul-Sep;21(3):281-97.	5
11 Altamura AC, Mundo E, Bassetti R, et al. Transcultural differences in suicide attempters: analysis on a high-risk population of patients with schizophrenia or schizoaffective disorder. <i>Schizophr Res</i> . 2007 Jan;89(1-3):140-6.	3
12 Ancoli-Israel S, Cooke JR. Prevalence and Comorbidity of Insomnia and Effect on Functioning in Elderly Populations. <i>J Am Geriatr Soc</i> . 2005;53(Suppl. 7):S264-71.	5
13 Andersson N, Ledogar RJ. The CIET Aboriginal Youth Resilience Studies: 14 Years of Capacity Building and Methods Development in Canada. <i>Pimatisiwin</i> . 2008 Summer;6(2):65-88.	5

Excluded Trials	Exclusion Code
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