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Suicide prevention in the military: a mechanistic perspective

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In response to elevated suicide rates among U.S. military personnel, increased attention has focused on developing effective suicide prevention intervention strategies. Accumulating evidence from a series of recently-completed clinical trials focused on the treatment of suicide risk and posttraumatic stress disorder suggest two likely mechanisms of action for reducing suicidal thoughts and behaviors: emotion regulation and cognitive flexibility. The present article provides an overview of converging evidence from psychological, biological, and neurocognitive studies supporting the central role of emotion regulation and cognitive flexibility. The effects of various treatments on suicidal thoughts and behaviors, aggregated from seven clinical trials conducted with military personnel, are considered using this integrated clinical science perspective. Implications for intervention refinement and suicide prevention among military personnel are discussed.

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In 2008, after several years of increase, the suicide rate among U.S. Army and Marine Corps personnel surpassed the U.S. general population suicide rate, marking a significant departure from historical trends for lower rates in the military [1]. Suicide rates have risen in the Air Force and Navy as well, albeit relatively slower in comparison. In response, suicide prevention researchers both within and external to the military sought to identify the factors and variables that might be associated with this change, as well as strategies and interventions for reducing suicidal behavior in this population. After more than a decade of work, this research has largely confirmed that many of the correlates of suicidal thoughts and behaviors in non-military populations are applicable to the military as well: for example, male gender, psychiatric illness, relationship problems, and sleep disturbance. Given these similarities between military and non-military populations, suicide prevention strategies that are effective in non-military populations may have applicability to the military.

Consistent with this possibility, several clinical trials have been implemented to test the efficacy of treatments initially developed in non-military settings when used with military personnel. In the past few years, six clinical trials have reported suicide-specific outcomes among military personnel, two of which were trials reporting primary outcomes of treatments designed to specifically target suicide risk reduction [2••,3,4••] and three were trials reporting secondary outcomes of treatments designed to specifically target posttraumatic stress disorder (PTSD) [5,6•,7•]. Prior to these studies, only one study had examined the efficacy of a treatment designed to reduce suicide risk among military personnel [8]. Findings from these seven trials that are specific to suicidal thoughts and behaviors are summarized in Table 1, and suggest several general trends. First, significant reductions in suicidal behavior occur in brief cognitive behavioral therapy (BCBT) and crisis response planning (CRP), both of which are based on a common conceptual model and treatment protocol, but the same effects were not seen in a partial hospitalization program that employed group CBT or the Collaborative Assessment and Management of Suicidality (CAMS). Second, suicide ideation declines to a comparable degree across all treatments, regardless of its focus (i.e., suicide risk, trauma, or other problems in life). Third, reductions in suicide ideation may be somewhat larger and longer-lasting in cognitively-oriented trauma therapies. The observed similarities and differences across these various treatments provide clues for identifying and understanding the mechanisms of action that contribute to suicide risk reductions among military personnel.

Studies implicating mechanisms of action for suicide risk reduction

The foundation for understanding possible mechanisms of action for suicide risk reduction was first articulated by Rudd *et al.* [9] based on a review of dozens of published clinical trials, which led to the identification of several essential components of effective treatments (see Table 2). These components were subsequently applied to military settings and used to guide the adaptation of suicide-focused treatments (specifically, BCBT and CRP) for this population [10]. Of particular relevance to the identification of mechanisms of action are two of the six components: basing the treatment on a simple, empirically-supported conceptual model and emphasizing skills training. A good conceptual model provides a

Table 1

Summary of reported outcomes from clinical trials examining treatment effects on suicidal thoughts and behaviors conducted among military samples.

Study	Treatment conditions	Length of follow-up	Findings
Primary analyses of suicide risk treatment studies			
Bryan *et al.* (2017)	Indiv. CRP versus TAU	6 months	•Significant group difference in attempts (5% in CRP versus 19% in TAU) •Significant reduction in suicide ideation in both groups at all follow-ups; larger and faster reduction in CRP
Jobes *et al.* (in press)	Indiv. CAMS versus TAU	12 months	•No group difference in attempts (11% in CAMS versus 5% in TAU) •Significant reduction in suicide ideation in both groups at all follow-ups; larger reduction in CAMS at 3 months only
Rudd *et al.* (1996)	Group CBT versus TAU	12 months	•No group difference in attempts (3% in group CBT versus 1% in TAU) •Significant reduction in suicide ideation from baseline to 6 months and baseline to 12 months in both groups; no group differences
Rudd *et al.* (2015)	Indiv. BCBT versus TAU	24 months	•Significant group difference in attempts (14% in BCBT versus 40% in TAU) •Significant reduction in suicide ideation in both groups at all follow-ups; no group differences
Secondary analyses of PTSD treatment studies			
Brown *et al.* (in press)	Indiv. PE versus Indiv. PCT	6 months	•No group difference in attempts (1% in PE versus 1% in PCT) •Significant reduction in suicide ideation from baseline to 3 months but no difference from baseline to 6 months across both groups; no group differences
Bryan *et al.* (2016)	Group CPT versus Group PCT	12 months	•No group difference in attempts (no attempts in either group) •Significant reduction in suicide ideation in both groups; no group differences
Resick *et al.* (2017)	Group CPT versus Indiv. CPT	6 months	•No group difference in attempts (2% in group CPT versus 0% in individual CPT) •Significant reduction in suicide ideation from baseline to 6 months in individual CPT but not group CPT; no group differences

simple, straightforward explanation for understanding *why* a patient thinks about suicide and/or engages in suicidal behavior. More specifically, understanding the utility of a patient's thoughts and behaviors provides and understanding of where patients have potential skills deficits. These areas of deficits are likely to be the mechanisms maintaining the suicidal thoughts and behaviors. In turn, these deficits should lead to the selection of procedures and interventions that directly target those issues and provide the patient with a more adaptive option that conceptually matches interventions with each deficit. The conceptual model should therefore dictate which skills to prioritize and provide the rationale for doing so. Without a strong conceptual model guiding

Table 2

Common elements of treatments with demonstrated efficacy for reducing suicidal thoughts and behaviors.

Element	Description
Conceptual model of suicide	Effective treatments are based on simple, clinically-useful models that explain why a person engages in suicidal behavior and what should be done to prevent suicidal behavior.
Clinician fidelity	Effective treatments provide protocols (or manuals) that enable clinicians to administer procedures in a consistent manner that reliably targets the central mechanisms underlying suicide risk. These manuals typically allow clinicians to select from a menu of predetermined techniques, thereby balancing reliability with flexibility.
Patient adherence	Effective treatments target patient engagement and motivation and articulate what is expected of patients, thereby ensuring that treatment interventions and procedures accurately target the central mechanisms contributing to their suicidal thoughts and behaviors.
Skills training	Effective treatments teach patients to use specific strategies designed to undermine the factors that contribute to their suicidal thoughts and behaviors.
Patient responsibility and autonomy	Effective treatments empower patients to employ skills, strategies, and procedures within their own lives, and invites feedback from patients regarding the utility of these activities.
Clear guidance for crisis resolution	Effective treatments teach patients how to identify emerging crises and provide clear steps to follow in order to resolve them. These steps include self-management skills as well as easy access to external sources of support, when needed.

an understanding of each patient's suicidal thoughts and behaviors, the selection of interventions and procedures becomes difficult and haphazard.

Accumulating evidence indicates that suicidal thoughts and behaviors among military personnel are largely driven by the desire to reduce or escape from emotional distress [11,12]. These findings align with the results of numerous neurological studies implicating brain regions associated with emotion regulation and decision-making processes. For example, individuals who have attempted suicide have increased connectivity of brain regions implicated in emotional processing [13], decreased connectivity in regions associated with emotion regulation [14–16], and blunted hypothalamic–pituitary–adrenal axis activity in response to stressors [17]. Consistent with this line of evidence, perceived difficulty in controlling one's behaviors when emotionally distressed and limited ability to differentiate between emotions are correlated with suicide attempts [18–20]. Although studies conducted in non-military samples suggest that distress tolerance — one facet of emotion regulation — may be associated with increased risk for suicidal behavior [21], among military personnel the opposite pattern has been noted: deficits in perceived distress tolerance (e.g., *I can't stand this pain anymore; It is unbearable when I get this upset*) are correlated with suicidal thoughts and behaviors, and prospectively predict suicidal behavior among military personnel better than other suicide risk factors including recent suicide ideation [22,23]. This may suggest that distress tolerance contributes to suicide risk in a different way among military personnel. Alternatively, it may highlight conceptual differences between distress tolerance, which entails the capacity to endure aversive psychological states, and emotion regulation, which entails the capacity to influence when and how one experiences (and expresses) different emotions. Specifically, the perceived inability to alter, change, or otherwise influence negative emotional states may be more central to the emergence of suicidal behavior than one's ability to tolerate or endure these uncomfortable states. Additional research is needed to test this possibility.

Individuals who attempt suicide also demonstrate a strong attentional bias toward suicide-related and death-related cues [24]. These suicide-specific attentional biases have proven to be better predictors of future suicidal behavior than other traditional risk factors for suicide such as depression, hopelessness, and suicide ideation [25] and reflect a diminished desire to live [26] as well as diminished executive functioning, particularly in the areas of attentional control, preservation, and set-shifting [25–28]. In addition, individuals who attempt suicide have a weakened expected reward signal in the paralimbic cortex that is correlated with an exaggerated preference for smaller immediate rewards versus larger delayed rewards [29] and a tendency to overemphasize the reward or punishment experienced during their most recent learning trial at the expense of prior learning experiences [30,31], although this tendency may be more characteristic of less lethal suicide attempts [32]. This provides a mechanism for understanding the finding that military personnel who attempt suicide are ten times more likely to make another suicide attempt if they experience reductions in emotional distress afterwards [12]: they are more likely to remember or weigh this consequence even if it contradicts other, earlier experiences. Military personnel who are vulnerable to suicidal behaviors may therefore 'get stuck' in high-risk states characterized by intense autonomic arousal, cognitive rigidity, and impaired problem solving [33].

Implications for suicide prevention interventions among military personnel

Overall, converging data from neural, psychological, and behavioral studies implicate two key mechanisms for the reduction of suicidal behaviors: emotion regulation and cognitive flexibility. Suicide prevention interventions that target these two core mechanisms effectively match with this conceptual model of suicide. Consistent with this assumption, the treatments with demonstrated efficacy for reducing suicidal behavior among military personnel — BCBT and CRP — emphasize training in emotion regulation skills training and cognitive flexibility. In BCBT, for instance, procedures include relaxation training, which targets autonomic arousal, and mindfulness and cognitive reappraisal training, both of which target rumination and cognitive rigidity. Additionally, BCBT allows for the provider to have a manual of skills to choose from that fit with the specific deficits the patient is presenting. This allows for the considerable structure of a manualized treatment to be balanced with flexibility: by selecting skills that best fit with the patient's unique needs with respect to emotion regulation and cognitive rigidity, the clinician can optimally sequence procedures while also maintaining high fidelity to the underlying treatment model. In CRP, the patient is helped to identify practical self-regulation strategies that can be used in response to stressful situations and/or emotional crises. Similar to BCBT, structure is balanced with flexibility by allowing clinicians and patients to identify and select optimal self-regulation strategies without dictating what these strategies must be. Emotion regulation is therefore targeted in a way that meets the needs of each individual patient. BCBT and CRP also focus on identifying and reinforcing the suicidal individual's reasons for living, which undermines suicide-specific cognitive biases. Traditional approaches to treating suicidal patients that focus on psychiatric diagnoses and their associated symptoms are therefore less effective because they do not reliably or sufficiently target these core mechanisms.

In addition to providing clues that explain why some treatments demonstrate superiority as compared to other

treatments, a mechanistic perspective may provide clues that explain why others do not. For example, despite its focus on emotion regulation and cognitive flexibility, group CBT did not show an advantage with respect to reducing suicidal thoughts or behaviors among military personnel relative to treatment as usual, although it was better at improving problem solving [8]. The limited efficacy of group therapy for suicide risk has been observed in non-military samples as well [34]. This may suggest a 'dilution' effect, such that treatments are less potent when delivered in a group context. This potential for dilution is further suggested by a recent component analysis of dialectical behavior therapy (DBT), which found that patients who received individual therapy during DBT tended to maintain gains over the long-term better than patients who received DBT without individual therapy [35]. Although these group differences were not statistically significant, the authors nonetheless noted that they were clinically meaningful.

A mechanistic perspective may also provide context for understanding differential patterns of effects across BCBT, CRP, and CAMS. As compared to treatment as usual, BCBT showed superiority with respect to reducing suicide attempts but not ideation, CAMS showed superiority with respect to reducing suicide ideation but not attempts, and CRP showed superiority with both suicide ideation and attempts. All three approaches focus on suicide risk as the primary treatment goal and allow for skills training focused on emotion regulation and cognitive flexibility, although the methods by which they integrate skills training vary. Specifically, BCBT and CRP designate emotion regulation and cognitive flexibility as primary treatment targets and prescribe certain procedures to hit these targets, but allow clinicians the freedom to select the sequence of procedures that best meets the patient's needs. These interventions therefore provide a 'menu' of options to choose from.

CAMS, in contrast, designates as primary treatment targets individual-level mechanisms of action (referred to as 'drivers of suicide') that can vary from patient to patient. In addition, CAMS does not prescribe specific procedures to use or skills to teach, which may increase variability in treatment administration. In other words, CAMS allows clinicians to select specific procedures from a menu of options, but instead of providing a menu for clinicians to choose from, CAMS allows clinicians to create their own menu. CAMS may therefore be addressing mechanisms that are more directly associated with suicide ideation but may not be addressing emotion regulation and cognitive flexibility with sufficient specificity to see a more pronounced effect on suicidal behavior. This potential interpretation is limited by an important caveat of the CAMS trial: the treatment as usual group had an unusually low rate of suicide attempts, only 5% during the 12-month follow-up. By comparison, 20% of military personnel had made a suicide at the 12-month assessment in the BCBT trial and 19% had made a suicide attempt at the 6-month assessment in the CRP trial. Confounding factors unique to the sample enrolled in the CAMS trial could therefore account for the study's diminished effects.

Finally, a mechanistic perspective provides some insight regarding the pattern of findings in the three military PTSD trials published to date. Because suicide risk was not the primary outcome for any of these trials, they were not powered to examine treatment effects on suicidal behavior. They were, however, sufficiently powered to examine suicide ideation as a secondary outcome. Interestingly, the pattern of findings across all three PTSD studies generally aligned with the results of the four suicide trials. First, effects were somewhat larger in individual therapy as compared to group therapy, although not statistically significant. This converges with the 'dilution' hypothesis noted above. Second, short-term reductions in suicide ideation during PTSD therapies that used cognitively-oriented procedures such as Socratic questioning tended to be maintained for up to 12 months whereas short-term reductions in suicide ideation in PTSD therapies that did not use cognitively-oriented procedures tended to return to baseline levels by the 6-month assessment. This pattern suggests that cognitive flexibility may be an especially important mechanism of suicide risk reduction. Furthermore, the conceptual framework underlying PTSD therapies overlaps considerably with the conceptual framework of suicide described above. The observed patterns may therefore reflect 'spillover' effects of PTSD therapies onto suicide risk. Conversely, there may be 'spillover' effects of suicide-focused therapies on PTSD. Consistent with this possibility, BCBT contributed to significant reductions in PTSD symptom severity that were moderately larger (though only marginally significant) than those seen in treatment as usual [4••].

Summary

Converging evidence from neurobiological, psychological, and behavioral studies point to emotion regulation and cognitive flexibility as two likely mechanisms of action contributing to suicidal behavior among military personnel. The results of several recently-completed clinical trials suggest that, when suicide-focused treatments and interventions target these two key mechanisms, significant reductions in suicidal thoughts and behaviors result among military personnel. Accumulating evidence from clinical trials of PTSD treatments that similarly target these mechanisms lend further support to this possibility. To date, no clinical trials conducted in military samples have utilized methodology that could test emotion regulation and cognitive flexibility as potential mechanisms of action in treatments that reduce suicidal thoughts and behaviors. Such research could

enhance the refinement of treatments and interventions for suicide prevention among military personnel.

Conflict of interest statement

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