# Longitudinal suicide ideation trajectories in a clinical trial of brief CBT for U.S. military personnel recently discharged from psychiatric hospitalization

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A B S T R A C T

Research among adolescent samples has suggested patterns of change in suicidal ideation (SI) following psychiatric hospitalization discharge are heterogenous and predictive of subsequent suicide attempts. However, no studies have examined SI trajectories following discharge among adult samples or the effect of treatment on trajectories. We used growth mixture modeling to examine trajectories of SI among 152 active duty military personnel in a randomized controlled trial comparing brief cognitive-behavioral therapy (CBT) for suicide prevention to treatment as usual following discharge from inpatient psychiatric hospitalization for a suicide risk. Analyses of SI at baseline, 3-, 6-, and 12-months post-discharge among the full sample randomized to both conditions revealed two trajectories: rapid improvers (59.21%) and gradual improvers (40.79%). Gradual improvers were more than twice as likely to attempt suicide in the two years following discharge. Exploratory analyses suggested that, relative to those in the treatment as usual condition, those randomized to brief CBT in both trajectories may be less likely to make a suicide attempt during the follow-up period. Results replicate and extend prior research in identifying distinct ideation trajectories following psychiatric inpatient hospitalization for suicide risk to active-duty personnel in a treatment trial and linking these trajectories to suicide attempts during follow-up.

## 1. Introduction

The suicide rate among active duty United States military personnel has increased significantly since the onset of Operations Enduring Freedom (OEF), Iraqi Freedom (OIF), and New Dawn (OND; Department of Defense, 2010; Kuehn, 2009). Department of Defense records indicate the suicide rate among active duty personnel increased from roughly 10 per 100,000 in 2001 to nearly 24.8 per 100,000 in 2018 (Department of Defense, 2019). Accordingly, suicide prevention among current and former service members has been identified as a national healthcare and research priority (Hoge et al., 2011; Executive Order Number 13625, 2012; Executive Order Number 13861, 2019).

The days and weeks immediately following psychiatric hospitalization discharge has been established as a period of exceptionally high suicide risk (e.g., Goldacre et al., 1993; Meehan et al., 2006). Among

the active duty population, those recently released from psychiatric hospitalization are more than eight times more likely to die by suicide (Luxton et al., 2013). Accordingly, this exceptionally high-risk window has been a focus of much risk identification and intervention research.

One approach to identifying those at greatest risk during this window has been to examine patterns of change in suicidal ideation (SI). Czyz et al. (2012) used growth mixture modeling to identify patterns of change in SI among adolescents 3-, 6-, and 12-months post-discharge and found that participants were best grouped into three categories: those with low initial SI that remained low following discharge, those with high initial SI that decreased and remained low following discharge, and a third group characterized by high initial SI that remained elevated over the 12 month period. Participants in the group characterized by high initial SI that remained elevated over the 12 month period were 2–4 times more likely to attempt suicide and 3–11 times more likely to be re-hospitalized during the follow-up

period relative to the other two trajectories. Finally, Czyz, Liu, and King found that baseline depression, externalizing, and hopelessness were the strongest predictors of SI trajectory. Accordingly, trajectories of SI over time appear to have important differences in prospective risk. Similarly, Prinstein and colleagues (2008) used growth curve modeling to examine patterns of change in SI over time in the 18 months following psychiatric hospitalization discharge among adolescents. They found, on average, SI decreased from inpatient care through the first few months post-discharge, then began to increase. Additionally, Prinstein et al. found that individuals who experienced less decrease in SI from inpatient care through the first few months post-discharge were more likely to make a subsequent suicide attempt. Collectively, these results indicate, at least among adolescent samples, patterns of change in SI over time following psychiatric hospitalization discharge are both heterogenous and predictive of subsequent suicide attempts.

Most research on SI patterns post-discharge have focused on adolescents. Indeed, no research to date has examined longitudinal SI course among active duty personnel following psychiatric hospitalization discharge. Beyond the unique nature of adolescent suicidal populations, the active duty population differs from the civilian population in numerous important ways, including self-injurious thoughts and behaviors (e.g., Ursano et al., 2014). Accordingly, different patterns may emerge among active duty service members. Likewise, no studies have examined how intervention during the post-discharge window impacts risk differently among different ideation trajectories. This is critical to considering resources needed to allocate for specific groups based on risk following psychiatric hospitalization for suicide risk.

The aims of this study was to conduct secondary data analysis of a randomized controlled trial of Brief Cognitive Behavioral Therapy (BCBT; Rudd et al., 2015) to identify distinct SI trajectories following psychiatric hospitalization discharge among active-duty personnel, identify predictors of SI trajectories, examine the differential risk between trajectories for future suicide attempts, and examine effect of BCBT within specific trajectories. We used growth mixture modeling to examine trajectories of SI among participants randomized to both BCBT and treatment as usual because efficacious interventions for suicide risk often do not differ from control conditions in effect on SI, including this trial (Rudd et al., 2015). Accordingly, conducted analyses among the full sample to examine the effect of treatment conduction on SI trajectory. Because the analytic technique we utilized in our approach is exploratory in nature, we did not make specific hypotheses regarding the number or characteristics of subsequent classes. Rather, we undertook this effort in order to determine if naturally occurring meaningfully distinct groups of patients could be identified.

## 2. Methods

### 2.1. Participants and procedure

The original study design for data collection is described in detail elsewhere (see Bryan et al., 2018; Rudd et al., 2015). Participants were recruited upon discharge from inpatient psychiatric hospitalization. Participants were eligible if they reported SI with intent to die during the past week and/or a suicide attempt within the past month, were active-duty military, 18 or older, able to speak English, and able to complete informed consent procedures. The only exclusion criterion was a medical or psychiatric condition that would preclude informed consent or participation in outpatient treatment (e.g., active psychosis or mania). Masters- and doctoral-level staff blind to treatment condition administered interview measures after completing training in each instrument. Eligible participants were evenly randomized to BCBT or treatment as usual (TAU).

All 152 participants randomized to treatment were included in analyses. Descriptive statistics of sample demographics are provided in Table 1. The majority of participants identified as male and White. Marital status was varied; the largest portion identified as married.

**Table 1**
Sample characteristics.

| Characteristic | n | % |
| --- | --- | --- |
| Male | 133 | 87.50% |
| Race | | |
| White | 110 | 72.37% |
| African American | 20 | 13.16% |
| Asian | 3 | 1.97% |
| Pacific Islander | 3 | 1.97% |
| Native American | 7 | 4.61% |
| Other | 12 | 7.89% |
| Hispanic/Latino | 34 | 22.37% |
| Marital status | | |
| Single | 31 | 20.39% |
| In a relationship | 9 | 5.92% |
| Married | 69 | 45.39% |
| Separated/Divorced | 42 | 27.63% |
| Widowed | 1 | 0.66% |
| Military rank | | |
| E1-E4 | 111 | 73.03% |
| E5-E6 | 35 | 23.03% |
| E7-E9 | 5 | 3.29% |
| Warrant Officer | 1 | 0.66% |
| Deployment history | | |
| 0 | 28 | 18.42% |
| 1 | 59 | 38.82% |
| ≥ 2 | 65 | 42.76% |
| Prior suicide attempts | | |
| 0 | 36 | 23.68% |
| 1 | 58 | 38.16% |
| ≥ 2 | 58 | 38.16% |
| Psychiatric diagnoses | | |
| Major depressive disorder | 118 | 77.63% |
| Posttraumatic stress disorder | 60 | 39.47% |
| Substance dependence | 20 | 13.16% |
| Alcohol dependence | 18 | 11.84% |
| Social anxiety disorder | 12 | 7.89% |
| Depressive personality disorder | 14 | 9.21% |
| Borderline personality disorder | 15 | 9.87% |
| Antisocial personality disorder | 8 | 5.26% |

*Note.* Only psychiatric diagnoses identified in ≥ 5% of the sample reported; $N = 152$.

Nearly three quarters of the sample were junior enlisted personnel. Most participants reported at least one deployment; over 38% reported ≥ 2 deployments. Most participants (76.32%) reported a history of at least one prior suicide attempt. Finally, most participants met diagnostic criteria of at least one psychiatric diagnosis; the disorder with the highest observed prevalence was Major Depressive Disorder. Mean age at baseline was 27.40 (SD = 6.20).

### 2.2. Treatment conditions

TAU consisted of a variety of mental health services directed by participants' primary mental health care providers. These services included support groups, psychiatric medication, substance abuse treatment, and individual and group psychotherapy provided by a mix of military and non-military community mental health providers. Participants in the BCBT condition received TAU care in addition to BCBT.

BCBT consists of 12 individual outpatient psychotherapy sessions organized into three phases. Phase 1 (5 sessions) involves an assessment of the suicide risk episode, identification of risk factors, cognitive behavioral case conceptualization, development of a crisis response plan, instruction in basic emotion regulation skills (e.g., mindfulness, relaxation), and provision of a small notebook called a "smart book" for writing down lessons learned in each session. Phase 2 (5 sessions) involves application of cognitive strategies to reduce beliefs functioning as vulnerability to future suicidal behavior (e.g., hopelessness, perceived burdensomeness, guilt and shame). Finally, phase 3 (2 sessions) involves a relapse prevention task requiring participants to demonstrate

acquired skills and knowledge.

Study therapists were two masters-level social workers, one early-career professional who was unlicensed at the start of the study and one senior professional who had been licensed for over a decade. Prior to the start of enrollment, therapists completed a two-week training program focused on suicide risk management, the BCBT protocol, and study procedures. One of the BCBT developers reviewed video recordings of sessions and provided feedback at least twice per week in individual and group supervision. Both BCBT therapists demonstrated excellent fidelity (see Rudd et al., 2015 for details).

### 2.3. Measures

We assessed SI using the Beck Scale for Suicidal Ideation (BSSI; Beck et al., 1988). The BSSI is a 19-item self-report measure of suicidal thoughts (e.g., wish to die, ideation duration) during the past week. The psychometric properties of the BSSI have been established in numerous populations, including internal consistency, test-retest reliability, construct validity, and value in predicting both suicide attempts and death by suicide. (Beck et al., 1988; Brown et al., 2006; Pinninti et al., 2002). The BSSI total score demonstrated excellent internal consistency at all time points ($\alpha > 0.90$ at all time points). We administered this questionnaire in self-report at baseline and by phone for follow-up assessments.

To assess suicide attempts, we used the Suicide Attempt Self-Injury Interview (SASII; Linehan et al., 2006). The SASII is a clinician-administered measure of self-injurious behavior characteristics. We defined a suicide attempt as deliberate self-directed behavior resulting in injury or potential for injury, with implicit or explicit evidence of suicidal intent. We assessed current psychiatric diagnoses at baseline using the Structured Clinical Interviews for *Diagnostic and Statistical Manual of Mental Disorders, fourth edition* (*DSM-IV*) Axis-I and Axis-II Disorders (First et al., 1996,1997).

We assessed suicide-related beliefs using the Suicide Cognitions Scale (SCS; Bryan et al., 2014). The SCS is an 18-item self-report measure of suicidal schemas related to unbearability and unlovability. Respondents rate the degree to which they agree with each item on a 5-point scale ranging from *disagree strongly* to *agree strongly*. The SCS total score evidenced strong internal consistency in the current study ($\alpha = 0.95$).

To assess hopelessness, we used the Beck Hopelessness Scale (BHS; Beck et al., 1974). The BHS is a 20-item self-report measure of negative beliefs about the future. Respondents rate each item as true or false. The BHS has demonstrated strong psychometric properties including utility in predicting death by suicide (Brown et al., 2006; McMillan et al., 2007). The BHS total score evidenced strong internal consistency in the current study ($\alpha = 0.93$).

We assessed sleep disturbance using the Insomnia Severity Index (ISI; Bastien et al., 2001). The ISI is a 7-item self-report measure of difficulty falling and staying asleep, as well as related distress and impairment, during the past two weeks. Respondents rate each item on a five-point scale; response options vary by item. The ISI has demonstrated excellent psychometric properties across several samples (Bastien et al., 2001; Morin et al., 2011). The ISI total score evidenced strong internal consistency in the current study ($\alpha = 0.88$).

To assess posttraumatic stress disorder (PTSD) symptoms, we used the PTSD Checklist (PCL; Weathers et al., 1993). The PCL is a 17-item self-report measure of PTSD symptoms during the past month. Respondents rate the degree to which they have been bothered by each symptom on a 5-point scale ranging from *not at all* to *extremely*. Strong psychometric support for the PCL has been established across numerous populations (see Wilkins et al., 2011 for a review). The PCL total score evidenced strong internal consistency in the current study ($\alpha = 0.94$).

We assessed depression at baseline using the Beck Depression Inventory, second edition (BDI-II; Beck et al., 1996). The BDI-II is a 21-item self-report measure of depression symptoms during the past two weeks. Respondents rate the degree to which they have been bothered by each symptom on a four-point scale; response options vary by item. The BDI-II has demonstrated strong psychometric properties in multiple populations (e.g., Dozois et al., 1998; Steer and Clark, 1997). The BDI-II total score evidenced strong internal consistency in the current study ($\alpha = 0.93$).

Lastly, we assessed perceived burdensomeness and thwarted belongingness at baseline using respective subscales for the Interpersonal Needs Questionnaire (INQ; Van Orden et al., 2012). The INQ is a 15-item self-report questionnaire of beliefs related to the interpersonal–psychological theory of suicidal behavior (Joiner, 2005). Respondents rate the degree to which they agree with a series of beliefs are true for them on a 7-point scale ranging from *not at all true for me* to *very true for me*. The perceived burdensomeness ($\alpha = 0.90$) and thwarted belongingness ($\alpha = 0.82$) subscales both demonstrated strong internal consistency in the current study.

### 2.4. Data analytic strategy

We used growth mixture modeling to examine heterogeneity in SI trajectories. Consistent with established procedures (Ram and Grimm, 2009), we first examined SI changes over time by visually inspecting raw data (see descriptive statistics in Table 2. Next, we compared a series growth curve models to determine how to most appropriately characterize SI change among the full sample. Models assuming no change (i.e., intercept only), linear change, and quadratic change were compared. We evaluated growth curve model fit using $\chi^2$, Bentler Comparative Fit Index (CFI), Tucker-Lewis Index (TLI), and Root Mean Square Error of Approximation (RMSEA). After identifying a best fitting growth curve model; we examined different solutions with an increasing number of classes until the models were no longer well-identified. We selected the models with the best fit to the data using Bayes information criterion (BIC; Schwartz, 1978), consistent Akaike's information criterion (CAIC; Bozdogan, 1987), and the approximate weight of evidence criterion (AWE; Banfield and Raftery, 1993), and compared fit of each model relative to a solution with one less class using the approximate Bayes factor (BF), the Schwartz information criterion (SIC; Schwartz, 1978), and the adjusted Lo-Mendell-Rubin likelihood ratio test (LMR-LRT; Lo et al., 2001). We compared all examined models using the approximate correct model probability (cmP; Kass and Wasserman, 1995). Finally, we evaluated precision of latent class assignment using average posterior class probability (AvePP) and odds of correct classification ratio (OCC; Nagin, 2005), as well as entropy as an overall index of precision as well as for class-specific

**Table 2**

Descriptive statistics of included measures.

| Measure | Mean | SD | Min | Max | Skewness | Kurtosis |
|---|---|---|---|---|---|---|
| BDI-II | 32.73 | 13.81 | 0 | 60 | −0.49 | −0.42 |
| BHS | 12.80 | 6.05 | 0 | 20 | −0.65 | −0.87 |
| INQ-PB | 20.89 | 12.98 | 0 | 42 | −0.11 | −1.14 |
| INQ-TB | 24.87 | 7.10 | 7 | 42 | −0.13 | −0.59 |
| ISI | 17.09 | 6.22 | 0 | 28 | −0.57 | 0.02 |
| PCL | 56.27 | 16.89 | 17 | 85 | −0.47 | −0.59 |
| SCS | 51.85 | 17.31 | 18 | 89 | −0.45 | −0.44 |
| SSI | | | | | | |
| Baseline | 13.10 | 8.74 | 0 | 36 | 0.30 | −0.83 |
| 3-Months | 6.87 | 8.00 | 0 | 33 | 1.35 | 1.08 |
| 6-Months | 6.96 | 7.06 | 0 | 31 | 1.39 | 1.82 |
| 12-Months | 5.21 | 5.35 | 0 | 25 | 1.72 | 2.45 |

*Note.* BDI-II = Beck Depression Inventory, second edition; BHS = Beck Hopelessness Scale; INQ-PB = Interpersonal Needs Questionnaire Perceived Burdensomeness subscale; INQ-TB = Interpersonal Needs Questionnaire Thwarted Belongingness subscale; ISI = Insomnia Severity Index; PCL = Posttraumatic Stress Disorder Checklist; SCS = Suicide Cognitions Scale; SSI = Scale for Suicidal Ideation.

**Table 3**

Growth curve model fit among the full sample.

| Model | $\chi^2$ | df | p | RMSEA | 95% CI | CFI | TLI | SRMR |
|---|---|---|---|---|---|---|---|---|
| Intercept only | 122.960 | 11 | <.001 | 0.259 | 0.219–0.301 | <0.001 | 0.054 | 0.429 |
| Linear change | 44.370 | 8 | <.001 | 0.173 | 0.125–0.224 | 0.436 | 0.577 | 0.220 |
| Quadratic change* | 30.512 | 7 | <.001 | 0.149 | 0.097–0.205 | 0.636 | 0.688 | 0.179 |
| Piecewise | 4.107 | 4 | .392 | 0.013 | 0.000–0.124 | 0.998 | 0.998 | 0.045 |

*Note.*

\* = quadratic slope variance set to zero to facilitate model convergence.

diagnostics. We selected a final, best-fitting model based on review of fit indices, classification diagnostics, and conceptual model interpretability.

We conducted all analyses using robust maximum likelihood estimation (MLR) in Mplus version 7 (Muthén & Muthén, 1998). We used full-information maximum likelihood estimation (FIML) to handle missing data in all analyses. Consistent with concerns regarding problems arising from model specifications (Infurna and Luthar, 2016), we fully estimated within- and between-class variability over time.

## 3. Results

### 3.1. Growth curve models

Fit statistics for examined growth curve models are presented in Table 3. Intercept only, linear, and quadratic growth curve models provided poor fit to the data. Review of mean values indicated change in SI was not consistent across follow-up periods; the change in SI between baseline to 3-month was greater than the change in SI from 3-month to 12-month follow-up. This pattern consistent with previous work examining SI patterns post-discharge (e.g., Prinstein et al., 2008). Accordingly, we examined a piecewise growth curve model which examined SI change during these two periods separately. This model provided excellent fit to the data.

Results from this model indicate that, on average, SI at baseline ($M = 13.10$, SE $= 0.71$) decreased from baseline to the 3-month assessment ($M = -5.79$, SE $= 0.79$, $p < .001$), and decreased to a lesser extent from the 3-month to the 12-month assessments ($M = -0.93$, SE $= 0.39$, $p = .016$). Variances were significant for the intercept ($M = 76.35$, SE $= 6.68$, $p < .001$) and baseline to 3-month slope ($M = 57.50$, SE $= 11.65$, $p < .001$), but not for the 3-month to 12-month slope ($M = 5.23$, SE $= 3.34$, $p = .106$), indicating initial ideation level and patterns of change immediately following discharge were characterized by signification heterogeneity.

### 3.2. Growth mixture modeling

We examined solutions with an increasing number of classes until models failed to converge. Solutions with greater than 3 classes repeatedly failed to converge even after making model adjustments. Among solutions with 1–3 classes, indices were consistent in favoring a two-class solution (see Table 4). The two-class solution was supported by the lowest observed BIC, CAIC, and AWE values, BF value indicative of strong evidence of this solution relative to a 3-class solution, a

**Table 5**

Growth mixture modeling 2-class solution classification diagnostics.

| Class | Estimated proportion | AvePPk | OCCk |
|---|---|---|---|
| 1 | 0.53 | 0.86 | 5.50 |
| 2 | 0.47 | 0.96 | 23.69 |

*Note.* AvePPk = average posterior class probability; OCCk = odds of correct classification ratio.

significant adjusted LMR-LRT *p* value for the 2-class solution but not for the 3-class solution, and a cmP value indicating that, among models considered, very high probability (0.98) a 2-class solution was the most appropriate. We evaluated classification diagnostics for each class within the 2-class solution (see Table 5). AvePP and OCC values exceeded cutoffs (0.70 and 5.00, respectively; Nagin, 2005) indicative of a solution with well-separated classes and high assignment accuracy.

Parameter estimates for the two-class solution are reported in Table 6. Class 1 (~60% of the sample) was characterized by lower baseline ideation, which decreased significantly from baseline to 3-months, then increased significantly (though the magnitude of this increase was quite small) from 3-months to 12-months post-baseline. Class 2 (~40% of the sample) was characterized by higher initial ideation, which decreased from baseline to 3-months, but to a lesser degree than in class 1, and decreased again from 3-months to 12-months, but never approached observed reduction in class 1 (see Fig. 1). Intercept and slope variances were significant in both classes, indicating both trajectories were characterized by significant heterogeneity. Collectively, class 1 appeared to reflect participants with lower initial ideation who experienced rapid ideation reduction ("rapid improvers"), whereas improvement was more gradual in class 2 ("gradual improvers").

### 3.3. Predictors of ideation trajectories

Demographic characteristics, deployment history, suicide attempt history, and diagnostic status were not predictive of ideation trajectories (see Table 7). However, greater baseline depression symptom severity, PTSD symptom severity, hopelessness, perceived burdensomeness, and suicide cognitions were each associated with increased likelihood of belonging in the gradual improvers trajectory. Accordingly, ideation trajectory appears better accounted for by related suicide risk factors than by psychiatric diagnoses and demographics.

**Table 4**

Mixture modeling fit indices.

| Solution | LL | BIC | CAIC | AWE | BF | Adj. LRT p | cmP |
|---|---|---|---|---|---|---|---|
| 1-Class | −1418.63 | 2887.49 | 2920.88 | 3014.52 | <0.001 | – | <0.001 |
| 2-Class | −1329.50 | 2759.47 | 2826.26 | 3013.52 | 47.13 | <0.001 | 0.98 |
| 3-Class | −1305.72 | 2767.17 | 2870.70 | 3160.96 | – | 0.33 | 0.02 |

*Note.* Adj. LRT *p* = adjusted Lo-Mendell-Rubin likelihood ratio test; AWE = approximate weight of evidence criterion; BF = Bayes factor; BIC = Bayes information criterion; CAIC = consistent Akaike's information criterion; cmP = correct model probability; LL = log-likelihood.

**Table 6**
Two-class growth mixture modeling solution.

|  | Class 1 | | Class 2 | |
| --- | --- | --- | --- | --- |
|  | Estimate | S.E. | Estimate | S.E. |
| Means |  |  |  |  |
| Intercept | 10.39* | 1.06 | 16.12* | 1.16 |
| Slope baseline – 3 months | −8.45* | 1.02 | −3.10* | 1.27 |
| Slope 3 months – 12 months | 0.56* | 0.18 | −2.39* | 0.75 |
| **Variances** |  |  |  |  |
| Intercept | 63.69* | 12.03 | 73.14* | 9.65 |
| Slope baseline – 3 months | 55.89* | 10.02 | 43.68* | 19.31 |
| Slope 3 months – 12 months [+] | – | – | 8.51 | 5.93 |
| **Covariances** |  |  |  |  |
| Intercept - baseline – 3 months | −59.04* | 10.89 | −37.38* | 12.60 |
| Intercept - slope 3 months – 12 months | −0.32 | 1.14 | −21.89* | 6.16 |
| Slope baseline – 3 months - 3 months – 12 months | 0.34 | 1.11 | 6.45 | 5.23 |
| Proportion of sample | 59.21% |  | 40.79% |  |

*Note.*

&ast; = $p < .05$; + = 3-month to 12-month slope variances were so small in class one they were fixed to zero to facilitate model convergence.

### 3.4. Predictive utility of trajectories

Of the 90 participants in the rapid improvers trajectory, 10 (11.11%) made a suicide attempt during the follow-up period. By comparison, of the 62 participants in the gradual improvers trajectory, 16 (25.81%) made a suicide attempt. Participants in the gradual improvers trajectory were 2.78 times more likely to attempt suicide during the follow-up period ($b = 1.02$, $SE = 0.44$, $p = .02$).

### 3.5. Effects of treatment

We conducted exploratory analyses to examine the degree to which BCBT differentially impacted suicide risk in each trajectory. As noted in the primary outcome manuscript (Rudd et al., 2015), conditions did not differ in demographic characteristics, psychiatric diagnoses, or prior history of suicide attempts at baseline. Within the rapid improvers trajectory, of the 50 participants randomized to BCBT, 4 (8.00%) made a suicide attempt during the follow-up period; of the 40 randomized to TAU, 6 (15.00%) made a suicide attempt during the follow-up period. Within the gradual improvers trajectory, of the 26 participants randomized to BCBT, 4 (15.38%) made a suicide attempt during the follow-up period; of the 36 randomized to TAU, 12 (33.33%) made a suicide attempt during the follow-up period (see Fig. 2). Although not adequately powered to test if treatment condition was predictive of significantly lower likelihood of a suicide attempt within each trajectory, descriptively, participants who were randomized to BCBT were 46.67% less likely to make a suicide attempt in the rapid improvers trajectory and 53.86% less likely to make a suicide attempt in the gradual improvers trajectory.

### 4. Discussion

This is the first examination of SI trajectories following psychiatric hospitalization discharge among active duty personnel and the impact of treatment on distinct trajectories. Results are consistent with previous research among adolescent samples in identifying distinct groups based on SI trajectories who vary in risk for future suicide attempts. Although SI decreased in both groups over time, a distinct class emerged that evidenced a far more gradual slope of SI decrease following hospitalization. This group was more than twice as likely to
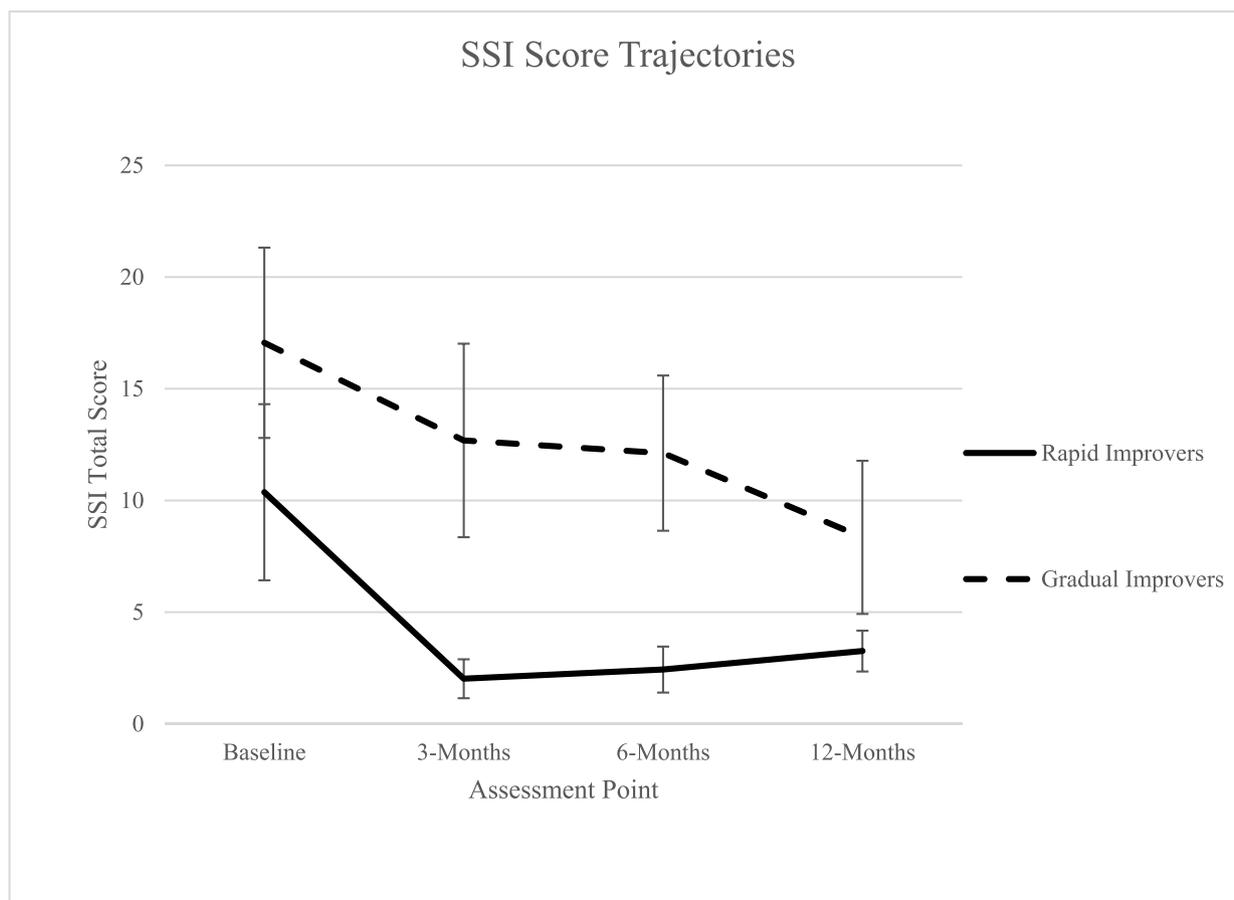


**Fig. 1.** Suicidal ideation trajectories.

**Table 7**
Bivariate logistic regression predicting trajectory membership.

| Bivariate analyses | *B* | *SE* | *p* |
|---|---|---|---|
| Age | 0.03 | 0.03 | .34 |
| Male | 0.55 | 0.49 | .27 |
| White | 0.16 | 0.37 | .68 |
| Hispanic ethnicity | −0.02 | 0.40 | .96 |
| In relationship | 0.35 | 0.33 | .29 |
| Deployment history | | | |
| Any | 0.87 | .47 | .07 |
| ≥ 2 | 0.28 | 0.33 | .41 |
| Prior suicide attempts | | | |
| Any | 0.52 | 0.46 | .26 |
| ≥ 2 | −0.10 | 0.34 | .77 |
| Psychiatric diagnoses | | | |
| Major depressive disorder | 0.47 | 0.41 | .26 |
| Posttraumatic stress disorder | 0.29 | 0.34 | .39 |
| Substance dependence | −0.04 | 0.49 | .94 |
| Alcohol dependence | 0.17 | 0.51 | .74 |
| Social anxiety disorder | −1.32 | 0.79 | .10 |
| Depressive personality disorder | −0.24 | 0.58 | .69 |
| Borderline personality disorder | 0.87 | 0.56 | .12 |
| Antisocial personality disorder | 0.39 | 0.73 | .59 |
| BDI-II | 0.03 | 0.01 | .01 |
| ISI | 0.03 | 0.03 | .23 |
| PCL | 0.03 | 0.01 | .02 |
| BHS | 0.08 | 0.03 | .01 |
| INQ-PB | 0.04 | 0.01 | <.01 |
| INQ-TB | 0.02 | 0.02 | .31 |
| SCS | 0.03 | 0.01 | <.01 |

*Note. b* = unstandardized regression coefficient; * = *p* < .05; BDI-II = Beck Depression Inventory, second edition; BHS = Beck Hopelessness Scale; INQ-PB = Interpersonal Needs Questionnaire Perceived Burdensomeness subscale; INQ-TB = Interpersonal Needs Questionnaire Thwarted Belongingness subscale; ISI = Insomnia Severity Index; PCL = Posttraumatic Stress Disorder Checklist; SCS = Suicide Cognitions Scale; SSI = Scale for Suicidal Ideation.

make a suicide attempt during the follow-up period.

Substantive efforts have been made to identify those at greatest risk for suicide, particularly during vulnerable periods such as following psychiatric hospitalization discharge (e.g., Kessler et al., 2015; Olfson et al., 2016). Two results from this study point toward a group

with distinctly greater risk. First, those in the gradual improvers group evidenced greater self-reported SI at baseline. This result suggests a relatively straightforward manner for identifying those at higher risk for future suicide attempts following discharge. Second, those in the gradual improvers group evidenced a more measured decrease in SI over time. Accordingly, repeated measurement of SI following discharge could prove useful in identifying those in need of additional treatment resource allocation.

Surprisingly, many examined risk factors, including demographics, treatment condition, self-injurious behavior history, and psychiatric diagnoses were not predictive of ideation trajectories. Perhaps the most notable of these null findings are treatment condition and self-injurious behavior history. In contrast, self-reported related risk characteristics including baseline depression symptom severity, PTSD symptom severity, hopelessness, perceived burdensomeness, and suicide cognitions were predictive of ideation trajectories. That psychiatric diagnoses assessed by SCID were not predictive of SI trajectory but disorders assessed by questionnaire were predictive is notable. In addition to the administration modality distinction, the SCID provides a dichotomous diagnostic status whereas questionnaire measures used provided continuous scores. Accordingly, although self-reported psychopathology severity may simply be more closely aligned with self-reported SI that clinician-rated diagnostic status, it also may be the case that dimensional ratings of psychopathology may be more useful than binary diagnostic status. Direct comparison of both possibilities is not possible in these data as continuous and binary versions of both interview and questionnaire measures are needed in order to make such conclusions. Nonetheless, these results suggest measurement of these constructs immediately following discharge has value in identifying those at greater risk for more chronic SI and future suicide attempts. One advantage of this finding is that these constructs were all measured using widely available self-report questionnaires that require few resources and low respondent burden.

Although this study was underpowered to detect a between-trajectory effect, descriptive statistics suggest BCBT may be beneficial for those in both rapid improver and gradual improver trajectories. This result builds on earlier research finding lower suicide attempt rates across multiple patient subgroups during and after BCBT (Bryan et al.,
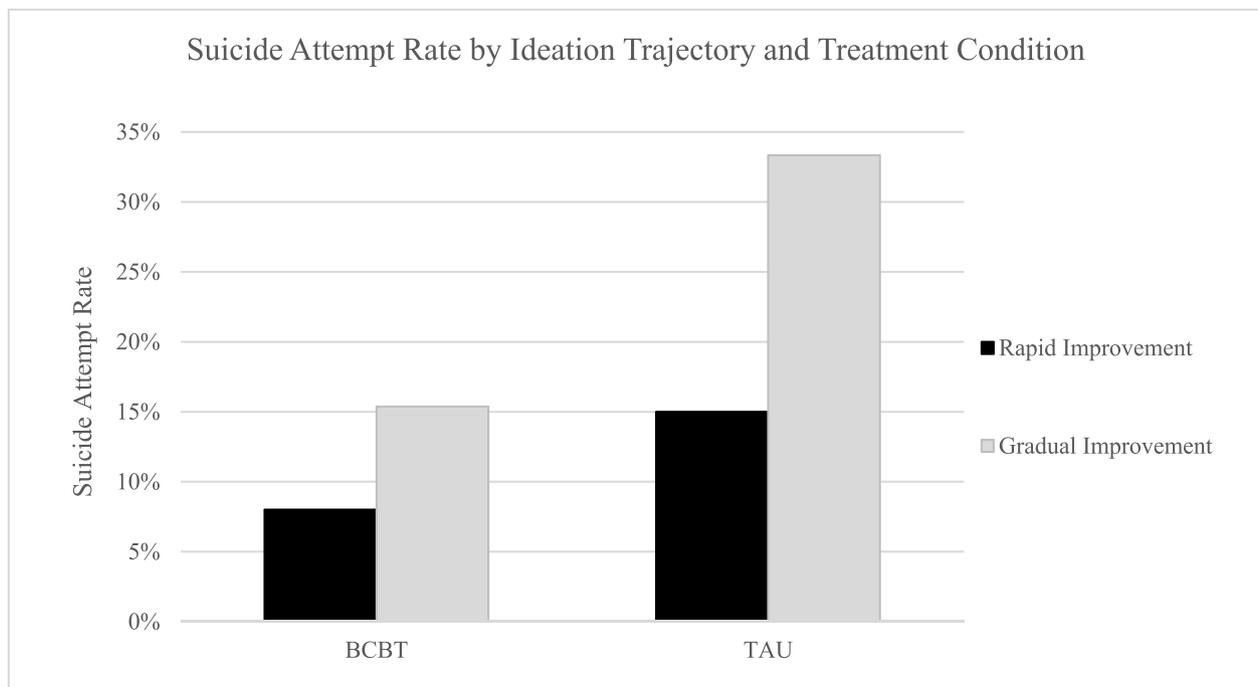


**Fig. 2.** Suicide attempts by ideation trajectory and treatment condition.

2018), and suggests that even patients identified as at higher risk in the gradual-recovery trajectory may nonetheless benefit from this form of intervention. This result should be interpreted in the context of descriptive statistics used and warrants further research adequately powered to fully explore this idea. Nonetheless, this pattern suggests that BCBT may be associated with decreased risk for suicidal behaviors even among patients who experience persistent suicidal ideation over time.

Clinically, these results indicate active duty personnel hospitalized for suicide risk should not be conceptualized as a single homogenous group in terms of SI patterns following discharge. Rather, these results indicate personnel who experience greater initial ideation that declines gradually following discharge appear at greater risk for subsequent suicide attempts. Given that these distinctions become most clear in the months following discharge, these results indicate monitoring patterns in SI months after discharge has utility in identifying meaningfully distinct groups. Despite the observed heterogeneity in trajectories, BCBT was descriptively associated with lower rates of suicide attempts across groups, suggesting the treatment may be able to reduce the probability of acting upon suicidal thoughts and impulses among different "types" of patients.

Results from this study should be interpreted within the context of several limitations. First, we measured SI intermittently using a self-report questionnaire. Kleiman and colleagues (2017, 2018) have found SI to be a far more temporally dynamic construct than once thought. By measuring SI intermittently, we may have missed important periods of fluctuation. Second, this sample was predominantly male and most participants identified as White. The degree to which observed trajectories extend to more sex- and race-diverse samples is an important future avenue for this work. Similarly, the sample consisted mostly of younger, junior enlisted personnel. Accordingly, the degree to which the results generalize to older non-commissioned officers and officers is unclear and also represents an important future direction for this research. Third, we administered the BSSI by self-report at baseline and by phone for follow-up assessments; some of the differences in scores on this measure across time could be attributable to differences in administration modality. Finally, the present sample included only active duty military personnel from one branch of service; generalizability to non-military populations may therefore be limited.

In conclusion, this study was consistent with research among adolescents in identifying distinct trajectories of SI over time following psychiatric hospitalization discharge and identified several predictors of identified trajectories. These results suggest measuring patterns of SI change following discharge has potential utility to identify those at greater risk of subsequent suicide attempts and, accordingly, in need of greater mental health resource allocation. Future work is needed to extend these findings to larger, more diverse samples, to other populations, and to examine the differential effect of treatment among distinct SI trajectories.

## CRediT authorship contribution statement

**Daniel J. Lee:** Conceptualization, Methodology, Software, Formal analysis, Writing - original draft, Visualization. **Craig J. Bryan:** Investigation, Resources, Data curation, Writing - review & editing, Supervision, Project administration, Funding acquisition. **M. David Rudd:** Investigation, Resources, Data curation, Project administration, Funding acquisition.

## Declaration of Competing Interest

None.

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