Research Paper

What Works in Youth Suicide Prevention? A Systematic Review and Meta-Analysis

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Keywords: Suicide prevention, Self-harm, Young people, Systematic review, Meta-analysis

1. Introduction

Suicide is the second-leading cause of death among young people and rates appear to be increasing [1]. Suicidal thoughts and behaviors (defined as suicide attempt or self-harm with clear or unclear suicidal intent) are more common than suicide [2] and predict future suicide and suicide attempts [3], with the period following a first suicide attempt associated with highest risk [4]. Presenting to hospital with self-harm significantly predicts subsequent suicide in youth [5], with the period immediately following discharge from psychiatric inpatient treatment associated with highest risk for suicide [6]. The period following hospital discharge therefore provides a crucial opportunity for intervention. Suicidal ideation is a necessary precursor to suicide attempt and as such also requires intervention. Although suicidal ideation is arguably a distinct concept from suicidal behavior, for ease of reading it is included under the term “suicide-related behavior” throughout this review unless otherwise specified.

The majority of OECD countries have a national suicide prevention strategy and many identify young people as requiring specific attention [7–9]. In accordance with international best practice, most strategies recommend a comprehensive approach to suicide prevention spanning universal approaches (i.e., delivered to the whole population), selective approaches (i.e., delivered to groups or communities believed to be at higher risk of suicide) and indicated approaches (i.e., delivered to individuals displaying suicide-related behaviors). Strategies also recommend interventions operate across a range of settings, including clinical, educational, workplace and community settings [1]. More recently, strategies have called for interventions to be delivered in digital, as well as face-to-face, settings [10,11].

Strategies must encompass evidence-based interventions if they are to reduce suicide [1]. Generating such evidence in suicide prevention, however, is complex [12]. Statistically, suicide is a relatively rare event, therefore it is often unfeasible to obtain sample sizes necessary to demonstrate the impact of interventions on this outcome. Moreover,
many interventions do not lend themselves to being tested using randomized controlled trials (RCTs), typically considered the gold-standard [13]. As such, researchers assess changes in other more prevalent outcomes, including self-harm and suicidal ideation, using alternative study designs. Therefore, when synthesizing the evidence regarding what works in youth suicide prevention, alternative study designs warrant consideration.

Whilst previous reviews have synthesized this evidence, many only include RCTs [14]. Additionally, many concentrate on particular settings (e.g., schools) or intervention type (e.g., gatekeeper training), and as such do not cover the full spectrum of approaches. The more comprehensive systematic reviews do not focus specifically on youth.

Evidence Before This Study

Prior to this study systematic reviews in suicide prevention have been limited by either only including RCTs, or by concentrating on particular settings (e.g., schools) or intervention type (e.g., gatekeeper training), and as such do not cover the full spectrum of approaches. The more comprehensive systematic reviews do not focus specifically on youth.

Added Value of This Study

This is the first systematic review and meta-analysis to synthesize the full spectrum of suicide prevention approaches in young people. It identified a large number of studies conducted across clinical, educational/workplace and community settings. Studies also tested the full spectrum of interventions including universal means restriction and educational interventions, selective interventions such as training programs, indicated interventions such as cognitive or dialectical behavior therapy, and multimodal interventions that combined education with either screening or gatekeeper training. The meta-analysis found that interventions delivered in both clinical and educational settings appear to have an impact on suicide-related outcomes at post-intervention and follow-up. In community settings, multifaceted, place-based approaches seem to have an impact on rates of suicide and self-harm. Overall, study quality was limited.

Implications of All the Available Evidence

The review identified that specific youth suicide-prevention interventions can reduce both self-harm and suicidal ideation in clinical, school and community settings, challenging the nihilism that often pervades in suicide prevention. Indeed, the number and range of studies identified by this review is encouraging and reflects increasing investment and best practice internationally when it comes to youth suicide prevention. However, there was an absence of studies conducted in low-middle income countries where large numbers of suicides occur, or with specific populations known to be at elevated risk of suicide, such as indigenous or same-sex attracted young people. Similarly, few studies were conducted in primary care, workplace or university settings, and very few utilized digital platforms. Additionally, many studies simply tested interventions that had previously been designed for adults as opposed to young people specifically. Together these findings suggest that important opportunities for youth suicide prevention are currently being missed. These gaps now need to be addressed by researchers, research funders, and by policy makers if we are to successfully address the rising rates of suicide among young people worldwide.

2. Methods

The methodology was informed by the Cochrane Collaboration [19] and the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines [20].

2.1. Study Selection and Classification

2.1.1. Inclusion Criteria

Studies of any design were eligible for inclusion in this review, provided they: [1] evaluated the impact of an intervention specifically designed to reduce suicide-related behavior; [2] assessed a suicide-related outcome, including suicide, suicide attempt, self-harm (defined as intentional self-injury and/or self-poisoning where suicidal intent was either not specified or was unclear), suicidal ideation, suicide risk, and/or reasons for living; [3] targeted young people aged 12–25 and/or if data on young people (mean age between 12-0 and 25-0) was specifically reported; [4] were published in a peer-reviewed journal or identified via the reference lists of included articles; and [5] were written in English.

2.1.2. Exclusion Criteria

Studies were excluded from the review if: [1] they were not implemented with the expressed and primary purpose of preventing or reducing suicide-related behavior. Under this criterion, studies of indicated interventions were excluded if they did not recruit participants based on present or recent suicidal ideation or behavior. Additionally, studies of means restriction approaches were included only if the intervention was implemented, wholly or partially, to prevent suicide. As such, studies of firearm regulations implemented with the expressed and primary purpose of preventing homicide were excluded under this criterion. Studies were also excluded if they: [2] did not measure and report on a suicide-related outcome (as defined above); this included studies that exclusively measured non-suicidal self-injury, as this is generally considered to be a separate phenomenon; [3] did not target young people, or if data relating to outcomes for young people could not be disaggregated from that adults; [4] employed a non-experimental design; [5] were not published in a peer-reviewed journal; [6] were not available in English; or [7] did not contain any unique relevant data over and above the first included study.

2.2. Search Strategy

We searched Medline, PsycINFO, and EMBASE from January 1 1990 to September 21, 2017. Keywords relevant to suicide-related behavior, intervention type and youth were combined using standard Boolean operators (see Appendix). Key words were developed by consensus among the author group and in consultation with a librarian. In addition, we hand-searched the reference lists of all previous reviews retrieved via the search.

In the first instance study titles and abstracts were screened by five of the review authors (EB, JR, SH, NS, KW). Due to the large number of
studies retrieved two review authors independently screened 10% of the total number of records retrieved. Cohen’s Kappa [21] was 0.748 and Prevalence-Adjusted and Bias-Adjusted Kappa (PABAK) [22] was 0.978, indicating excellent agreement regarding inclusion and exclusion of studies. Discrepancies were resolved by discussion. In the second stage of screening, full texts of potentially relevant studies were screened for inclusion by four authors (EB, JR, SH, NS). Full text double-screening was not undertaken, but review authors met regularly to resolve any queries.

2.3. Data Extraction and Classification

Data were extracted independently by seven authors (JR, EB, SH, NS, KW, DC, AM) using a pilot tested pro forma. The following information was extracted: (i) author(s) and publication date; (ii) country; (iii) study design; (iv) setting from which participants were recruited; (v) study sample or population characteristics; (vi) intervention description; (vii) details of control or comparison group (classified as treatment as usual (TAU), enhanced TAU and placebo), and; (viii) outcome data on suicide deaths, suicide attempt, suicidal ideation, suicide-related behavior, and/or self-harm at the point of post-intervention and (where appropriate) longest follow-up (note that follow-up periods varied). Where studies used more than one measure for an outcome, data from the measure that was most commonly used across all included studies were used, as has been done previously [23]. Two authors (SH and KW) undertook double data entry of all outcome data.

Studies were classified according to the following taxonomy. In the first instance studies were classified according to the setting from which the participants were recruited (i.e. clinical, education or workplace, and community). If participants were recruited from multiple settings, the study was classified according to the setting from which participants were primarily recruited. Studies were then classified by study design (i.e. RCTs and non-RCTs) and then by intervention approach (i.e. universal, selective, indicated). Some studies combined a number of different intervention approaches. In these cases studies were classified as ‘multi-modal’ when the intervention comprised a number of different components implemented together (e.g. psycho-education AND screening), and ‘multiple’ when studies tested the impact of different interventions that were implemented separately (e.g. psycho-education program in location A and gatekeeper training in location B). They were then classified according to intervention type (e.g. means restriction, educational, therapeutic). For the therapeutic interventions, the therapeutic modality itself was also specified. For example, within this category there were a number of studies that tested cognitive behavioral therapy (CBT), dialectical behavioral therapy (DBT) and so on.

2.4. Study Quality

An assessment of study quality was conducted. For all RCTs, this was based on the Cochrane Collaboration Risk of Bias Tool [19]. In the majority of trials, as is often the case [24], blinding of participants and therapists was not possible. Each trial was therefore assessed with regard to random sequence generation, allocation concealment, ascertainment of self-harm, outcome assessor blinding, whether analyses were conducted according to the intention-to-treat (ITT) principle, and rates of attrition. For the latter criterion, an attrition rate of 15% or less on the primary outcome at the longest follow-up point indicated low risk of bias.

Non-RCTs were assessed in two ways. For those conducted in clinical, educational, or workplace settings (where a range of study designs were employed) we used a set of criteria based on resources from the Cochrane Effective Practice and Organization of Care (EPOC) group [25]. We assessed whether or not: [1] the study was adequately powered; [2] outcome assessors were blinded to treatment allocation (for studies where outcomes were measured via interview); [3] the attrition rate was below 15%; and [4] the authors used statistical testing to measure change.

Studies in community settings employed either an ecological or interrupted time series design. Here two criteria were used to assess quality: whether or not data were collected at multiple time points before and after the intervention [26], and whether or not the intervention itself was likely to affect data collection. “Multiple time points” was defined as at least twice before or after implementation of the intervention. The intervention was considered not to affect data collection if sources and methods of data collection were the same before and after the intervention, or if data were collected from official sources (e.g. coronial records).

2.5. Data Synthesis

Meta-analysis was only conducted for RCTs. We analyzed data separately according to study setting. Because self-harm can encompass suicide attempts, is a key predictor of future suicide [27], and is more prevalent and more commonly assessed than suicide, self-harm (measured dichotomously) was our primary outcome and all dichotomous self-harm and suicide attempt data were combined. Additional outcomes were self-harm measured continuously, suicide and suicidal ideation (measured dichotomously and continuously). Where studies had more than one intervention arm, we included those arms that provided relevant data and split the control group to avoid double counting [28].

For dichotomous data, we pooled data between studies using the relative risk with 95% confidence interval. For continuous outcomes, given the range of different tools used, means and standard deviations were pooled using the standardized mean difference (SMD) using the Hedges’ adjusted g with a 95% confidence interval. SMD effect sizes of 0-2 were considered small, 0-5 were considered medium, and ≥0.8 were considered large [29]. Measurement scales were standardized so that higher scores were indicative of greater levels of suicidal ideation. For both continuously- and dichotomously-measured outcomes, pooled effect size estimates were calculated using the DerSimonian-Laird random effects model [30] implemented using Comprehensive Meta-Analysis 2.2.064 software [31].

Between-study heterogeneity was measured using the I² statistic. I² values of 25%, 50% and 75% or larger are indicative of small, moderate and high heterogeneity, respectively [32].

![Fig. 1. PRISMA flow diagram.](image-url)
2.5.1. Subgroup Analysis

For the primary outcome we undertook three subgroup analyses to investigate whether the intervention approach, intervention type and, for those interventions coded as psychotherapy, the therapeutic modality modified the pooled effect sizes.

First, intervention approach was coded as universal, selective or indicated. Second, type of intervention was categorized as psychotherapy, brief contact, or educational. Psychotherapy interventions were established psychotherapeutic approaches belonging to a particularly theoretical or philosophical school. Brief contact interventions were defined as those interventions that either: [1] focused on maintaining contact or facilitating re-engagement with services via a minimal amount of supportive contact, including provision of an emergency or crisis card as defined by Milner et al. [33]; or [2] interventions delivered within a very brief period, such as screening and referral or provision of one-off assessment and supportive therapy. Educational interventions delivered psycho-education about suicide-related behaviors, mental illness associated with these behaviors, signs and symptoms to look out for and advice on how to respond. Finally, trials coded as psychotherapy were further categorized by modality as either: CBT; DBT; mentalisation therapy; problem solving; motivational interviewing; supportive therapy; family therapy; interpersonal psychotherapy; combined (where several modes of psychotherapy were combined); or other (where the intervention did not clearly fit any category of named therapeutic approach).

2.5.2. Sensitivity Analysis

The robustness of results of the meta-analysis was checked for the primary outcome by conducting sensitivity analyses. RCTs judged as high or unclear risk of bias for allocation concealment, and RCTs where more than 15% of participants were lost to follow-up or where no data were reported, were excluded from this analysis.

For studies in which no data amenable to meta-analysis were reported, a narrative synthesis of results was conducted.

3. Results

3.1. Search Results

In total, 34,463 articles were retrieved via database searching and an additional four via the reference lists of included articles. Following initial screening, 572 full-text articles were retrieved, of which 105 met our inclusion criteria. Six were secondary publications that were included as they reported novel data [34–39]. The review therefore includes findings from 105 articles corresponding to 99 unique studies (see Fig. 1).

3.2. Overall Description of Included Studies

Half (52.5%) of included studies were conducted in clinical settings (Tables 1 and 2), 31 (31.3%) in educational or workplace settings (Tables 3 and 4), and 16 (16.2%) in community settings (Tables 5 and 6). Most studies tested indicated interventions (k = 66; 66.7%), followed by universal (k = 17; 17.2%), multimodal (k = 11; 11.1%), and selective (k = 2; 2.0%) interventions. Three studies (3.0%) evaluated multiple interventions. Forty-eight studies (48.5%) were RCTs. This included 33 (63.5%) of the studies conducted in clinical settings and 15 (48.4%) of those conducted in educational or workplace settings. None of the community-based studies were RCTs.

The majority of studies were conducted in the United States of America (k = 49; 49.5%), followed by the United Kingdom (k = 12; 12.1%) and Australia (k = 11; 11.1%). Some were conducted across multiple countries and only two (2.0%) were conducted in low-middle income countries. The number of studies more than doubled in the period of 2005–2017 compared to 1990–2004.

3.3. Studies Conducted in Clinical Settings

Fifty-two of the included studies were conducted in clinical settings and all tested indicated interventions delivered to young people with a history of self-harm or attempted suicide resulting in presentation to hospital-based or mental health services. Outcomes therefore refer to repeated self-harm in these studies. Thirty-three were RCTs. Forty (76.9%) had a mean participant age of 18 years or younger, eight studies (15.4%) had a mean age over 18, and in four studies (7.7%) the mean age could not be determined.

3.3.1. Randomized Controlled Trials

3.3.1.1. Study Description. Participants were recruited from emergency departments, inpatient units and community mental health services/outpatient clinics. One study was set in a military hospital [40]. Studies examined the impact of a range of interventions, including individual and group cognitive behavioral therapy (CBT), dialectical behavioral therapy (DBT), family therapy, and brief contact interventions. Control conditions included TAU, e.g. routine care, enhanced TAU, e.g. safety monitoring and facilitated referrals, and active placebo e.g. problem oriented support but without a specific skills-based training component.

Twenty-four (72.7%) of the studies in this category included participants with a mean age of 18 or younger. Please see Table 1.

3.3.1.2. Study Efficacy. Thirty-two of the 33 clinical RCTs reported data amenable to meta-analysis. Twenty-five were psychological interventions [40–64] and seven were brief contact interventions [65–71]. The results of the meta-analysis, classified according to outcome assessed, are reported below. The primary outcome (self-harm) is reported first, followed by suicidal ideation; suicide is reported last as it was least frequently assessed.

3.3.1.2.1. Self-harm Measured Dichotomously. Compared to controls, there was no evidence of any intervention effect on self-harm at post-intervention (k = 12, RR = 0.889, 95% CI 0.71 to 1.11, I² = 37.1%) (Fig. 2). At follow-up there was some evidence of a reduction in the proportion of people who had received an intervention who went on to have a repeat self-harm episode (k = 16, RR = 0.83, 95% CI 0.70 to 0.99, I² = 40.9%) (Fig. 3).

3.3.1.2.2. Sensitivity Analysis. There was no material change to the outcome at post-intervention when studies at high risk of bias for allocation concealment were removed. At follow-up, when studies at high risk of bias were removed, the effect was no longer significant.

3.3.1.2.3. Subgroup Analysis. There was no evidence that the type of intervention modified the size of the treatment effect post-intervention (p = 0.67) or at follow-up (p = 0.09); nor was there any evidence that therapy modality modified the size of the treatment effect post-intervention (p = 0.13), or at follow-up (p = 0.08).

3.3.1.2.4. Self-harm Measured Continuously. Compared to controls, there was little evidence, with high heterogeneity (I² = 94.4%), that the intervention resulted in a reduction in the mean number of self-harm episodes at post-intervention (k = 5, SMD = −0.66, 95% CI −1.45 to 0.13), and there was limited evidence of this at follow-up (k = 4, SMD = −0.23, 95% CI −0.49 to 0.03, I² = 58.9%).

3.3.1.2.5. Suicidal Ideation Measured Dichotomously. Compared to controls, there was no evidence of any effect of intervention on the proportion of people who experienced suicidal ideation post-intervention (k = 7, RR = 0.89, 95% CI 0.68 to 1.16, I² = 83.0%) or at follow-up (k = 5; RR = 0.84, 95% CI 0.64 to 1.09, I² = 74.8%). Heterogeneity was high.

3.3.1.2.6. Suicidal Ideation Measured Continuously. Compared to controls, there was strong evidence of a small effect of the intervention on suicidal ideation post-intervention (k = 15, SMD = −0.28, 95% CI −0.48 to −0.08, I² = 76.3%). The effect was smaller at follow-up (k = 11, SMD = −0.18, 95% CI −0.34 to −0.02, I² = 41.1%).
Table 1
Randomized controlled trials conducted in clinical settings (N = 33).

<table>
<thead>
<tr>
<th>Study; country</th>
<th>Target population</th>
<th>Participants</th>
<th>Intervention description</th>
<th>Comparison condition</th>
<th>Risk of bias</th>
<th>Suicide related outcome(s) assessed; longest follow-up</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alavi et al.  (2013) [41] Iran</td>
<td>Inclusion: Young people admitted to hospital for a SA; Exclusion: SH w/o intent; no current SI; inability to participate in psychotherapy; diagnosed with bipolar, psychosis, pervasive developmental or substance use disorders</td>
<td>Whole sample N = 30 Mean age: 16.1 (SD: 1.4; Range: 12–18) Gender: 10% male Treatment group N = 15 Mean age: 16.1 (SD: 1.6) Gender: 6.7% male Control group N = 15 Mean age: 16.0 (SD: 1.2) Gender: 13.3% male</td>
<td>Individual cognitive behavioral therapy plus TAU Length: 12 sessions over 3 months Developed by: Stanley et al. (2009) Delivered by: NR</td>
<td>TAU: routine psychiatric intervention and follow up; pharmacotherapy if needed. Random sequence generation method: Alternate allocation Allocation concealment method: NR Ascertainment of SH repetition: Self-report Outcome assessor blinding: NR Less than 15% drop-out rate: Yes (11.0%) Was ITT analysis undertaken: TA</td>
<td>Random sequence generation method: Alternate allocation</td>
<td>SI (continuous): Beck Scale for Suicidal Ideation (BSS)</td>
</tr>
<tr>
<td>Asarnow et al. (2011) [65] USA</td>
<td>Inclusion: Young people who presented to ED with SA or SI; Exclusion: Acute psychosis or other symptoms that impede consenting and/or assessment process</td>
<td>Whole sample N = 181 Mean age: 14.7 (SD: 2.0; Range: 10–18) Gender: 30.9% male Treatment group N = 89 Mean age: 14.8 (SD: 2.1) Gender: 33.7% male Control group N = 92 Mean age: 14.6 (SD: 1.9) Gender: 28.3% male</td>
<td>Brief contact intervention Compliance enhancement measures mixed with family therapy plus TAU Length: 1 month Developed by: Based on Rotheram-Borus et al. (1996) and adapted by authors Delivered by: MH professionals</td>
<td>Enhanced TAU: usual ED care, with staff education on linking to treatment, reducing access to means, risks of substance use. Random sequence generation method: Computer generated algorithm Allocation concealment method: Independent researcher Ascertainment of SH repetition: Interview Outcome assessor blinding: Yes Less than 15% drop-out rate for SH at post-intervention: Yes (11.6%) Was ITT analysis undertaken: Yes</td>
<td>Random sequence generation method: Computerized randomization program</td>
<td>SI (dichotomous): DISC-IV, an clinician administered diagnostic interview SA (dichotomous): DISC-IV, an clinician administered diagnostic interview and Harkavy Asnis Scale (HASS)</td>
</tr>
<tr>
<td>Asarnow et al. (2017) [42] USA</td>
<td>Inclusion: i) Young people who had presented after engaging in SH (SA or NSSI included) within the last three months; ii). history of repetitive SH (≥ 3 lifetime episodes) Exclusion: symptoms interfering with participation in assessments or intervention (psychosis, substance use) and inability to speak English</td>
<td>Whole sample N = 42 Mean age: 14.62 (SD: 1.83) Gender: 11.9% male Treatment group N = 20 Mean age: 14.35 (SD: 1.81) Gender: 10.0% male Control group N = 22 Mean age: 14.86 (SD: 1.86) Gender: 13.6% male</td>
<td>SAFETY program Combined intervention consisting of CBT and DBT informed family intervention that included formulation driven CBT, DBT and family centered interventions. Each family had two therapists: one for the young person and one for the parents and there were joint family sessions as well as separated sessions. Length: 12 sessions over 3 months Developed by: study authors Delivered by: MH professionals</td>
<td>Enhanced TAU: in-clinic parent education on risk of repetition, accessing treatment; 3 + phone-calls monitoring safety, encouraging treatment attendance. Random sequence generation method: Computerized randomization program Allocation concealment method: Enrollment and assessment staff masked to randomization status Ascertainment of DSH repetition: Interview Outcome assessor blinding: Yes Less than 15% drop-out rate for SH at post-intervention: Yes (12.0%) Was ITT analysis undertaken: Yes</td>
<td>Random sequence generation method: Computerized randomization program</td>
<td>SA (dichotomous): used a slight modification of the clinician administered Columbia Suicide Severity Rating Scale (C-SSRS)</td>
</tr>
<tr>
<td>Bertolote et al. (2010) [66]; Fleischmann et al. (2008) [34] Multi-national</td>
<td>Inclusion: Young people who presented to ED following SH/self-poisoning Exclusion: ‘any clinical condition (s) that would disallow interview’ Recruited from: Hospital/ED</td>
<td>Whole sample N = 1867 Mean age: NR (Median = 23.0) Gender: 41.8% male Treatment group N = 922 Mean age: NR Gender: 40% male Control group N = 945 Mean age: NR Gender: 43.3% male</td>
<td>Brief contact intervention 1 1-hour information session plus 9 phone calls or visits. Length: Up to 10 contacts over 18 months Developed by: study authors (based on existing BIC methods) Delivered by: doctor, nurse or psychologist</td>
<td>TAU: varied between sites, primarily acute injury management with or without mental health referral. Random sequence generation method: Random numbers table Allocation concealment method: Offsite researcher Ascertainment of SH repetition: Interview Outcome assessor blinding: NR Less than 15% drop-out rate: Yes (11.0%) Was ITT analysis undertaken: Yes</td>
<td>Random sequence generation method: Random numbers table</td>
<td>SA (dichotomous): European Parasuicide Study Interview Schedule (EPSIS) of the WHO/EURO Multicenter Study on Suicidal Behavior</td>
</tr>
</tbody>
</table>
Byford et al. (1999) [43]  
**UK**  
**Inclusion:** Diagnosis of SH (self-poisoning)  
**Exclusion:** Overdose was accidental; psychiatric condition which would preclude engagement with therapy; social situation precluded engagement with family therapy  
**Recruited from:** MH outpatient  
**Whole sample**  
N = 162  
Age/gender: NR  
**Treatment group**  
N = 85  
Age/gender: NR  
**Control group**  
N = 77  
Age/gender: NR  
**Individual family therapy plus TAU**  
**Length:** 1½ hour assessment plus 1 h of therapy  
Developed by: study authors  
Delivered by: MH professionals  
**TAU:** routine assessment and psychiatric care in outpatient clinic.  
**Random sequence generation method:** Shuffled cards  
**Allocation concealment method:** Sealed envelopes  
**Ascertainment of SH repetition:** interview  
**Outcome assessor blinding:** Yes  
**Less than 15% drop-out rate:** Yes (8.0%)  
**Was ITT analysis undertaken:** NR  
Carter et al. (2010) [44]  
**Australia**  
**Inclusion:** Females referred for treatment following self-poisoning, meeting criteria for borderline personality disorder, with at least three self-reported episodes of self-harm over the preceding year.  
**Exclusion:** Males, those engaging in self-injury without self-poisoning  
**Recruited from:** MH outpatient  
**Whole sample**  
N = 70  
Mean age: 24.5 (SD: 6.1; Range: 18–65)  
Gender: 0% male  
**Control group**  
N = 37  
Mean age: 24.5 (SD: 6.1)  
**TAU + Waitlist:** 6 month period of unspecified TAU while waitlisted.  
**TAU:** type and duration varied: CBT, motivational interviewing, supportive counseling, family therapy; medication and case management as needed.  
**Random sequence generation method:** Shuffled envelopes  
**Allocation concealment method:** Sealed, opaque envelopes  
**Ascertainment of SH repetition:** Interview  
**Outcome assessor blinding:** Yes  
**Less than 15% drop-out rate:** Yes (0.0%)  
**Was ITT analysis undertaken:** Mixed methods  
Cooney et al. (2010) [45]  
**New Zealand**  
**Inclusion:** History of at least one SA or one episode of SH in past three months  
**Exclusion:** i) Intellectual disability; ii) Psychosis  
**Recruited from:** MH outpatient  
**Whole sample**  
N = 29  
Mean age: 15.9 (SD: 1.0; Range: 14–18)  
Gender: 24.1% male  
**Control group**  
N = 15  
Mean age: 15.7 (SD: 1.1)  
Gender: 20% male  
**Brief contact intervention**  
**Emergency card allowing readmission to hospital on request.**  
**Random sequence generation method:** Computer generated algorithm  
**Allocation concealment method:** Sealed, opaque envelopes  
**Ascertainment of SH repetition:** Interview  
**Outcome assessor blinding:** Yes  
**Less than 15% drop-out rate:** Yes (0.0%)  
**Was ITT analysis undertaken:** Mixed methods  
Diamond et al. (2010) [46]  
**Whole sample**  
N = 66  
Mean age: 15.2 (SD: 1.62; Range 12–17)  
**Individual family therapy plus TAU**  
**Length:** Up to 15 sessions  
**Enhanced TAU:** safety monitoring and facilitated referrals for treatment (incl. SI (continuous): SIQ-Junior (SIQ-JR))  
**Random sequence generation method:** Adaptive randomization  
**Longest follow-up:** Post-intervention only  
(continued on next page)
<table>
<thead>
<tr>
<th>Study; country</th>
<th>Target population</th>
<th>Participants</th>
<th>Intervention description</th>
<th>Comparison condition</th>
<th>Risk of bias</th>
<th>Suicide related outcome(s) assessed; longest follow-up</th>
</tr>
</thead>
<tbody>
<tr>
<td>USA</td>
<td>following a second screen. Exclusion: i) Current psychosis; ii) mental retardation/history of borderline intellectual functioning Recruited from: Hospital/ED and primary care practices (75.0% were recruited from primary care and 25.0% from hospitals/EDs)</td>
<td>Gender: 16.7% male Treatment group N = 35 Mean age: 15.1 (SD: 1.41) Gender: 8.6% male Control group N = 31 Mean age: 15.3 (SD: 1.83) Gender: 25.8% male</td>
<td>delivered over a 3-month period Developed by: study authors Delivered by: trained PhD or Masters level therapists</td>
<td>Individual, group, or family therapy, or case management). Allocation concealment method: Independent researcher Ascertaintment of SH repetition: Interview Outcome assessor blinding: No Less than 15% drop-out rate: Yes (0.0%) Was ITT analysis undertaken: No</td>
<td>Longest follow-up: 3 months post-intervention</td>
<td></td>
</tr>
<tr>
<td>Esposito-Smythers et al. (2011) [48] USA</td>
<td>Inclusion: SA in past 3 months or scored $\geq$41 on the SIQ (Reynolds, 1987) Exclusion: i) Verbal IQ score $\leq$70; ii) Psychosis; iv) Bipolar disorder; iii) Dependent on substances other than alcohol or cannabis Recruited from: MH outpatient</td>
<td>Whole sample N = 40 Mean age: 15.7 (SD: 1.19; Range: 13–17) Gender: 33.3% male Treatment group N = 20 Mean age: 15.8 (SD: 0.98) Gender: 31.6% male Control group N = 20 Mean age: 15.7 (SD: 1.41) Gender: 35.3% male</td>
<td>Individual cognitive behavioral therapy Length: 24 sessions delivered over 12 months Developed by: based on Donaldson et al. (2005) and Esposito Smythers et al. (2006) and adapted by study authors Delivered by: Trained therapists</td>
<td>Enhanced TAU: treatment schedule and approach determined by community providers. Diagnostic evaluation report provided. Study psychiatrist assisted with medication management. Access to information and resources. Random sequence generation method: Computer generated adaptive randomization Allocation concealment method: Unclear Ascertaintment of SH repetition: Interview Outcome assessor blinding: Assessors could guess allocation due to offhand comments made by participants during interviews Less than 15% drop-out rate: No (25.0%) Was ITT analysis undertaken: No</td>
<td>SI (continuous): SIQ SA (dichotomous): Kiddie Schedule for Affective Disorders and Schizophrenia (K-SADS) – clinician administered diagnostic interview. Longest follow-up: 6 months post-intervention</td>
<td></td>
</tr>
<tr>
<td>Green et al. (2011) [49] UK</td>
<td>Inclusion: Presented to child and adolescent services with at least two episodes of SH in the past 12 months Exclusion: i) Severe low weight anorexia nervosa; ii) psychosis; iii) learning disability Recruited from: MH outpatient</td>
<td>Whole sample N = 366 Mean age: NR (Range: 12–16) Gender: 11.5% male Treatment group N = 183 Mean age: NR Gender: 11.5% male Control group N = 183 Mean age: NR Gender: 11.5% male</td>
<td>Group cognitive behavioral therapy Length: 6 sessions during the acute phase &amp; as many sessions needed during the maintenance phase Developed by: based on Wood et al. (2001) Delivered by: Trained therapists</td>
<td>TAU: routine care provided by local child &amp; adolescent mental health services according to clinical judgment, excluding group interventions. Random sequence generation method: Computer generated minimization algorithm Allocation concealment method: Independent, off-site researcher Ascertaintment of SH repetition: Interview Outcome assessor blinding: Yes Less than 15% drop-out rate: Yes (4.0%) Was ITT analysis undertaken: No</td>
<td>SI (continuous): SIQ JR SH (dichotomous): SIQ-JR Longest follow-up: 12 months post-baseline</td>
<td></td>
</tr>
<tr>
<td>Harrington et al. (1998) [50] UK</td>
<td>Inclusion: Presented to hospital with self-poisoning Exclusion: i) Other SH (e.g.</td>
<td>Whole sample N = 162 Mean age: 14.5 (SD: 1.15; Range: 10–16)</td>
<td>Five sessions of family therapy plus TAU Length: NR</td>
<td>TAU: routine psychiatric aftercare including diverse range of interventions, but no</td>
<td></td>
<td>SI (continuous): SIQ JR SH (dichotomous): SIQ JR Suicide: NR</td>
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<tr>
<td>Study</td>
<td>Inclusion</td>
<td>Exclusion</td>
<td>Recruited from</td>
<td>Gender</td>
<td>Treatment Group</td>
<td>Control Group</td>
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</tr>
<tr>
<td>Hassanian--Moghaddam et al. (2011) [68] Iran</td>
<td>Presented to hospital with self-poisoning</td>
<td>Psychosis</td>
<td>MH outpatient</td>
<td>10.5% male</td>
<td>N = 85</td>
<td>N = 77</td>
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<tr>
<td>Hazell et al. (2009) [51] Australia</td>
<td>Presented to hospital with &gt;2 episodes of SH</td>
<td>Intellectual disability</td>
<td>MH outpatient</td>
<td>33.7% male</td>
<td>N = 1043</td>
<td>N = 1070</td>
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<tr>
<td>Huey et al. (2004) [52] USA</td>
<td>Presented to hospital with SA/SI</td>
<td>Autism spectrum disorder</td>
<td>Hospital/ED</td>
<td>9.7% male</td>
<td>N = 35</td>
<td>N = 37</td>
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<tr>
<td>Husain et al. (2014) [53] Pakistan</td>
<td>Admitted to hospital following SH</td>
<td>Dementia; substance misuse; organic mental disorder; delirium</td>
<td>MH outpatient</td>
<td>31.2% male</td>
<td>N = 221</td>
<td>N = 219</td>
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</table>

(continued on next page)
<table>
<thead>
<tr>
<th>Study; country</th>
<th>Target population</th>
<th>Participants</th>
<th>Intervention description</th>
<th>Comparison condition</th>
<th>Risk of bias</th>
<th>Suicide related outcome(s) assessed; longest follow-up</th>
</tr>
</thead>
<tbody>
<tr>
<td>King et al. (2006)</td>
<td>Alcohol and/or drug dependence; vi) schizophrenia; vii) bipolar disorder; viii) intellectual disability</td>
<td>N = 108</td>
<td>&amp; Davidson (2004) and adapted by study authors</td>
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<tr>
<td></td>
<td>Recruited from: Hospital/ED</td>
<td>Mean age: 23.2 (SD: 5.8)</td>
<td>Delivered by: masters-level psychologists</td>
<td>Researcher;</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>Gender: 29.6% male</td>
<td></td>
<td></td>
<td>Ascertainment of SH repetition: Interview</td>
<td></td>
<td></td>
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<tr>
<td>King et al. (2009)</td>
<td>USA</td>
<td>Inclusion: i) SA or severe SI in past 3 months ii) Score of 20 or 30 on the Self-Harm subscale of the Child and Adolescent Functional Assessment Scale (Hodges, 1989)</td>
<td>Whole sample N = 289</td>
<td>Supportive intervention Youth nominated support team</td>
<td>TAU: varied, included psychotherapy, medication, alcohol/drug treatment, partial hospitalization, and community services.</td>
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<tr>
<td></td>
<td>Exclusion: i) Severe intellectual disability; ii) Psychosis</td>
<td>Mean age: 15.3 (SD: 1.5; Range: 12–17)</td>
<td>One-off brief psycho-education intervention for support team plus up to 9 contacts per week between adolescent and support team</td>
<td>SI (continuous): SIQ-JR</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Recruited from: Hospital/ED</td>
<td>Gender: 31.8% male</td>
<td>Length: 1.5 to 2 h</td>
<td>SI (dichotomous): SIQ-JR</td>
<td></td>
<td></td>
</tr>
<tr>
<td>King et al. (2015)</td>
<td>USA</td>
<td>Inclusion: Presented to ED with SI, a recent SA or positive screens for both depression plus alcohol/drug abuse</td>
<td>Whole sample N = 49</td>
<td>Individual motivational interview plus TAU</td>
<td>Enhanced TAU: adolescents given a crisis card and written information about depression, suicide, firearm safety, and services.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Exclusion: Required referral for inpatient psychiatric hospitalization</td>
<td>Mean age: 17.7 (SD: 1.7; Range: 14–19)</td>
<td>Length: 35–45 min</td>
<td>SI (continuous): SIQ-JR</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Recruited from: Hospital/ED</td>
<td>Gender: 40% male</td>
<td>Developed by: study authors (based on standard motivational interviewing protocols)</td>
<td>Longest follow-up: 2 months post-baseline</td>
<td></td>
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</tr>
<tr>
<td>McLeavey et al. (1994)</td>
<td>Republic of Ireland</td>
<td>Inclusion: Presented to ED with self-poisoning</td>
<td>Whole sample N = 39</td>
<td>Individual Interpersonal Problem-Solving Skills Training Length: Five weekly one-hour sessions for 5 weeks (with 1</td>
<td>Active placebo: brief problem-oriented approach, did not involve skills training.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Exclusion: Required psychiatric inpatient/day-hospital admission;</td>
<td>Mean age: 24.4 (SD: 7.0; Range 15–45)</td>
<td>Gender: 25.6% male</td>
<td>Random sequence generation method: Shuffled envelopes</td>
<td>SH (dichotomous): ED readmission</td>
<td></td>
</tr>
</tbody>
</table>

### Table: Interventions and Comparator Conditions

#### Study Details

**Mehlum et al. (2016) [58]**
- **Country**: Norway
- **Inclusion**: Referred to child & adolescent psychiatric outpatient clinic with a history of ≥2 episodes of self-harm; 1 within the past 16 weeks
- **Exclusion**: i) Bipolar disorder (except bipolar II); ii) Schizophrenia; iii) Affective disorder; iv) Psychosis NOS; v) Intellectual disability; vi) Asperger’s syndrome
- **Recruited from**: Hospital/ED
- **Whole sample**: N = 77
  - Mean age: 15.6 (SD: 1.6; Range: 12–18)
  - Gender: 20% male
- **Treatment group**: N = 39
  - Mean age: 15.9 (SD: 1.4)
  - Gender: 12.8% male
- **Control group**: N = 38
  - Mean age: 15.3 (SD: 1.6)
  - Gender: 20.3% male

#### Treatments

- **Dialectical Behavior Therapy**
  - Length: 19 weeks – One 1-hour weekly session of individual therapy; one 2-hour weekly session of multifamily skills training; plus family therapy & telephone coaching as needed.
  - Developed by: Miller et al. (2007)
  - Delivered by: MH professionals
  - **Enhanced TAU**: standard care enhanced for the purpose of the trial by requiring that therapists agree to provide at least 1 weekly treatment session per patient.

#### Outcomes

- **SI (continuous): SIQ-JR**
- **SH (dichotomous): ED readmission and self-report**
- **Suicide: Mortality records**
- **Longest follow-up**: 12 months post-intervention

---

**Ougrin et al. (2011) [69]; (2013) [39]**
- **Country**: UK
- **Inclusion**: Referred to ED following SH
- **Exclusion**: i) Psychois; ii) Intoxication; iii) Learning disability; iv) Required inpatient admission
- **Recruited from**: Hospital/ED
- **Whole sample**: N = 70
  - Mean age: 15.5 (SD: 1.3; Range: 12–18)
  - Gender: 20% male
- **Treatment group**: N = 35
  - Mean age: 15.6 (SD: 1.5)
  - Gender: 20% male
- **Control group**: N = 35
  - Mean age: 15.5 (SD: 1.2)
  - Gender: 20% male

#### Treatments

- **Brief contact intervention**
  - Comprised psychosocial history & risk assessment plus brief intervention
  - Length: 1 h plus 30 min
  - Developed by: study authors
  - **TAU**: standard psychosocial history and risk assessment, report sent to relevant community team

#### Outcomes

- **SH (dichotomous): ED readmission**
- **Longest follow-up**: 24 months post-baseline

---

**Pineda & Dadds, (2013) [59]**
- **Country**: Australia
- **Inclusion**: Presented to ED with either SI, SA or SH within the 2 months prior to presentation
- **Exclusion**: i) Overdose of recreational drugs; ii) Intellectual disability
- **Recruited from**: ED
- **Whole sample**: N = 48
  - Mean age: 15.1 (SD: 1.2; Range: 12–17)
  - Gender: 25% male
- **Treatment group**: N = 24
  - Mean age: 15.0 (SD: 1.31)
  - Gender: 27.3% male
- **Control group**: N = 24
  - Mean age: 15.28 (SD: 1.18)
  - Gender: 22.2% male

#### Treatments

- **Strengths-based family education program plus TAU**: Resourceful Adolescent Parent Program (RAP-P)
  - Length: Four 2-hour sessions delivered in a single family format either once a week or once every two weeks. A total of five, 2-hour sessions were provided over up to 2.5 months.
  - Developed by: based on Shochet et al. (1997) and adapted by study authors
  - Delivered by: primary author
  - **TAU**: routine care (included any intervention deemed necessary by the treating team other than RAP-P).

#### Outcomes

- **SI (continuous): ASQ-R**
- **Longest follow-up**: 6 months post-baseline

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<table>
<thead>
<tr>
<th>Study; country</th>
<th>Target population</th>
<th>Participants</th>
<th>Intervention description</th>
<th>Comparison condition</th>
<th>Risk of bias</th>
<th>Suicide related outcome(s) assessed; longest follow-up</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Age/gender: NR</td>
<td>Length: Eight to ten sessions over 10 weeks.</td>
<td></td>
<td>Allocation concealment method: NR</td>
<td>Longest follow-up: Post-intervention only</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Treatment group N = 31</td>
<td>Developed by: study authors</td>
<td></td>
<td>Ascertainment of SH repetition: Clinical records</td>
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<tr>
<td></td>
<td></td>
<td>Age/gender: NR</td>
<td>Delivered by: MH professionals</td>
<td></td>
<td>Outcome assessor blinding: NA</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Control group N = 25</td>
<td>**</td>
<td></td>
<td>Less than 15% drop-out rate: No (37.5%)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Age/gender: NR</td>
<td>**</td>
<td></td>
<td>Was ITT analysis undertaken: NR</td>
<td>**</td>
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<td></td>
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<tr>
<td>Robinson et al. (2012) [70] Australia</td>
<td></td>
<td>Whole sample N = 164</td>
<td>Brief contact intervention plus TAU – monthly postcards</td>
<td>TAU: treatment or support already being received; e.g., from school counselor, GP, psychologist.</td>
<td>Random sequence generation method: Block randomization using a computer generated sequence</td>
<td>Suicide: Not stated</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mean age: 18.6 (SD: NR; Range: 15–24)</td>
<td>Length: Twelve postcards over 12 months</td>
<td></td>
<td>Allocation concealment method: Independent researcher</td>
<td>Longest follow-up: 6 months post-intervention</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Gender: 35.4% male</td>
<td>Developed by: study authors (based on existing BIC methods)</td>
<td></td>
<td>Ascertainment of SH repetition: Interview</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Treatment group N = 83</td>
<td>Delivered by: NA</td>
<td></td>
<td>Outcome assessor blinding: Yes</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Mean age: NR</td>
<td>**</td>
<td></td>
<td>Less than 15% drop-out rate: Yes (52.7%)</td>
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<tr>
<td></td>
<td></td>
<td>Gender: 31.3% male</td>
<td>**</td>
<td></td>
<td>Was ITT analysis undertaken: No. However, sensitivity analyses were undertaken which suggested that ITT results with data imputed for all missing observations not materially different to per protocol analysis</td>
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<tr>
<td>Rossouw &amp; Fonagy, (2012) [61] UK</td>
<td></td>
<td>Whole sample N = 80</td>
<td>Mentalization therapy: comprised weekly individual sessions plus monthly family therapy.</td>
<td>TAU: routine care provided by community-based adolescent mental health services. Mainly individual therapeutic intervention, combined individual and family therapy, or psychiatric review.</td>
<td>Random sequence generation method: Minimization algorithm</td>
<td>Suicide: Not stated</td>
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<td></td>
<td></td>
<td>Mean age: 14.7 (SD: 1.25; Range: 12–17)</td>
<td>Length: 1 year</td>
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<td>Allocation concealment method: Independent, offsite researcher</td>
<td>SH (continuous): BSSI</td>
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<tr>
<td></td>
<td></td>
<td>Gender: 15% male</td>
<td>Developed by: study authors</td>
<td></td>
<td>Ascertainment of SH repetition: Interview</td>
<td>SH (dichotomous): Suicide Behavior Questionnaire-14 item version (SBQ-14)</td>
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<tr>
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<td>Treatment group N = 40</td>
<td>Delivered by: MH professionals.</td>
<td></td>
<td>Outcome assessor blinding: Yes</td>
<td>SA (dichotomous): SBQ-14</td>
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<td>Mean age: 15.4 (SD: 1.3)</td>
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<td>Less than 15% drop-out rate: Yes (11.23%)</td>
<td></td>
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<td></td>
<td></td>
<td>Gender: 17.5% male</td>
<td>**</td>
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<td>Was ITT analysis undertaken: Yes</td>
<td>**</td>
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<tr>
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<td>Control group N = 40</td>
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<tr>
<td></td>
<td></td>
<td>Mean age: 14.8 (SD: 1.2)</td>
<td>**</td>
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<td></td>
<td>**</td>
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<tr>
<td></td>
<td></td>
<td>Gender: 12.5% male</td>
<td>**</td>
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</tr>
<tr>
<td>Rudd et al. (1996) [40] USA</td>
<td></td>
<td>Whole sample N = 264</td>
<td>Group-based problem-solving and social competence training</td>
<td>TAU: combination of inpatient and outpatient care.</td>
<td>Random sequence generation method: Sequential randomization</td>
<td>Suicide: Not stated</td>
</tr>
<tr>
<td></td>
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<td>Mean age: 22.2 (SD: 2.3; Range: NR)</td>
<td>Length: 9 h a day for two weeks</td>
<td></td>
<td>Allocation concealment method: NR</td>
<td>SH (continuous): Modified Scale for Suicidal Ideation (MSSI)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Gender: 82.2% male</td>
<td>Developed by: study authors</td>
<td></td>
<td>Ascertainment of SH repetition: Interview</td>
<td>Longest follow-up: Post-intervention only</td>
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<tr>
<td></td>
<td></td>
<td>Treatment group N = 143</td>
<td>Delivered by: MH professionals</td>
<td></td>
<td>Outcome assessor blinding: NR</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mean age: NR</td>
<td>**</td>
<td></td>
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<td>Study</td>
<td>Inclusion</td>
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<td>Recruitment</td>
<td>MH outpatient</td>
<td>Control group</td>
<td>Treatment group</td>
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<tr>
<td>Slee et al. (2008) [62] The Netherlands</td>
<td>Presented to an outpatient MH service with recent SH</td>
<td>Psychiatric disorder requiring inpatient treatment</td>
<td>Recruited from: MH outpatient center</td>
<td>N = 121</td>
<td>Mean age: 14.6 (SD: 1.4; Range: 12–18)</td>
<td>Gender: 52.8% male</td>
</tr>
<tr>
<td>Spirito et al. (2015) [72] USA</td>
<td>Presented to an ED/pediatric hospital with SA</td>
<td>NR</td>
<td>Recruited from: Hospital/ED</td>
<td>N = 63</td>
<td>Mean age: 15.0 (SD: 1.4; Range: 12–18)</td>
<td>Gender: 52.8% male</td>
</tr>
<tr>
<td>Wharff et al. (2017) [63] USA</td>
<td>Presented to ED with “suicidality” or suicide attempt; presence of consenting parent or legal guardian</td>
<td>Not fluent in English; Not medically stable, including intoxication; cognitive ‘limitations’ preventing completion of research instruments; active psychosis; required physical or medical restraint in ED</td>
<td>Recruited from: Hospital/ED</td>
<td>N = 63</td>
<td>Mean age: 15.4 (SD: 1.5)</td>
<td>Gender: 50% male</td>
</tr>
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<table>
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<tr>
<th>Study; country</th>
<th>Target population</th>
<th>Participants</th>
<th>Intervention description</th>
<th>Comparison condition</th>
<th>Risk of bias</th>
<th>Suicide related outcome(s) assessed; longest follow-up</th>
</tr>
</thead>
<tbody>
<tr>
<td>UK</td>
<td>SH; ii) Engaged in SH on at least one other occasion during the past year Exclusion: i) 'Too suicidal' for ambulatory care; ii) psychosis; iii) learning 'problems' Recruited from: MH outpatient</td>
<td>Mean age: 14.3 (SD: 1.6; Range: 12–16) Gender: 22.2% male Treatment group N = 32 Mean age: 14.2 (SD: 1.1) Gender: 21.9% male Control group N = 31 Mean age: 14.3 (SD: 2.1) Gender: 25.8% male</td>
<td>Comprised aspects of cognitive behavioral therapy, dialectical behavioral therapy and psychodynamic psychotherapy. Length: “until the young person feels ready to leave” (p. 1247). Developed by: study authors Delivered by: MH professionals</td>
<td>psychiatric nurses &amp; psychologists. Included family sessions, nonspecific counseling, Psychotropic medication (where indicated).</td>
<td>table</td>
<td>Allocation concealment method: Independent, offsite researcher Ascertainment of SH repetition: Interview Outcome assessor blinding: Yes</td>
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Table 2
Study characteristics: Non-randomized controlled trials conducted in clinical settings (N = 19).

<table>
<thead>
<tr>
<th>Study; country</th>
<th>Study design; level of evidence</th>
<th>Target population</th>
<th>Participants</th>
<th>Intervention description</th>
<th>Comparison condition</th>
<th>Risk of bias</th>
<th>Suicide related outcome(s) assessed; Longest follow-up</th>
<th>Results</th>
<th>Interpretation</th>
</tr>
</thead>
</table>
| Azarnow et al. (2015) [73] USA | Case series | Inclusion: SA in past 3 months; stable living situation
Exclusion: No contact information available for follow-up; psychosis; substance abuse/depression; not English-speaking; no family to participate
Recruited from: Hospital/ED | N = 35
Mean age: 14.89 (SD: 1.6; Range: 11–18)
Gender: 14% male | Suicide-specific family-based cognitive behavioral therapy comprising psycho-education plus individual therapy.
The Safe Alternatives for Teens & Youths program (SAFETY Program)
Length: Up to 20 sessions over 12 weeks, incl: 1 x family session then individual (16 x youth-only & parent-only), then up to 16 x family sessions
Developed by: Henggeler (2002)
Delivered by: a MH professional | Adequately powered: NR
Outcome assessor blinding: NA
Less than 15% drop-out rate: Yes (11.4%)
Use of statistical testing to measure change from pre-test to post-test: Yes | SI: Harkavy-Asnis Suicide Survey, passive suicidal ideation subscale.
SA: Harkavy-Asnis Suicide Survey, suicide attempt subscale.
SRB: Harkavy-Asnis Suicide Survey, active suicidal behavior and ideation subscale.
Longest follow-up: 6 months post-intervention | SI: Pre-test
Post-test Mean (SD): 12.69 (9.79)
Post-test Mean (SD): 9.19 (10.14)
SA: Pre-test
Mean (SD): 0.89 (1.86)
Post-test Mean (SD): 0.13 (0.34)
SRB: Pre-test
Mean (SD): 3.71 (4.42)
Post-test Mean (SD): 1.81 (2.69) | There was evidence of a significant reduction in SI (t-test = 2.56, p = 0.016, Cohen’s d = 0.89), SA (t-test = 2.42, p = 0.019), and SRB (t-test = 2.63, p = 0.013) between baseline and three-month follow-up. Four young people either re-attempted suicide and/or re-engaged in NSSI during the treatment period (significance test not reported). |
| Brent et al. (2009) [91] USA | Pre-test/post-test | Inclusion: Had major unipolar mood disorder & SA in past 90 days; living with a parent or guardian who could participate in treatment
Exclusion: Substance dependence, bipolar disorder, psychosis, or developmental disorder
Recruited from: Unclear | Whole sample
N = 124
Mean age: 15.8 (SD: 1.5; Range: 12–18)
Gender: 22.6% male
Treatment group
Mean age: 17.2 (SD: 1.7; Range: 14–19)
Gender: 22.6% male
Control group
Mean age: 15.4 (SD: 1.4; Range: 13–18)
Gender: 22.6% male | Suicide-specific individual cognitive behavioral therapy with some elements of dialectical behavior therapy.
Length: between 12 and 16 weekly sessions
Developed by: Study authors
Delivered by: Unclear | Medication management or combined medication & CBT | Adequately powered: No
Outcome assessor blinding: No
Less than 15% drop-out rate: No (31.1%)
Use of statistical testing to measure change from pre-test to post-test: Yes | SI: Columbia Classification Algorithm of Suicide Assessment
SRB: Columbia Classification Algorithm of Suicide Assessment
Suicide: not described.
Longest follow-up: Post-intervention only | SA: NR
SRB: NR
Suicide: NR | There was evidence of an increase in SRB between baseline and six-month follow-up in the combination (i.e., psycho- and pharmacotherapy group) compared to either condition alone (22.9% vs. 23.8%; Fisher’s exact test p = 0.04). There was one completed suicide after the six-month follow-up, however, it is unclear to which treatment group this young person had been allocated. |
Exclusion: psychosis; developmental disorder
Recruited from: MH outpatient | Dialectical behavior therapy adapted for adolescents in tertiary care. A-DBT-A
Length: 1 x weekly group-based and 1 x weekly individual sessions over 14 weeks (session duration not stated).
Developed by: Based on Miller et al. (2006) but adapted by the study authors
Delivered by: A MH professional | Adequately powered: NR
Outcome assessor blinding: Yes
Less than 15% drop-out rate: No (49.2%)
Use of statistical testing to measure change from pre-test to post-test: Yes | SI: Suicidal Ideation Questionnaire (SIQ).
SRB: Medical/clinical records.
Suicide: NR
Longest follow-up: Post-intervention only | SI: Pre-test
Median (IQR): 131.0 (20.7 to 144.0)
Post-test Median (IQR): 77.0 (48.5 to 121.0)
SRB: NR
Suicide: NR | There was evidence of a significant reduction in SI (t-test = 4.96, p = 0.001, Cohen’s d = 0.89) between baseline and the 15-week post-intervention assessment. There was also evidence of a significant reduction in the proportion of young people engaging in SRB over this period (36/42 vs. 16/42; McNemar test p = 0.001). There were no reports of completed suicides. The number of participants who scored above the clinical cut-off for the SIQ seemed to decrease over the follow-up period. |
| Cwik et al. (2016) [82] USA | Pre-test/post-test | Inclusion: Apaches with SA in past 90 days
Exclusion: none
Recruited from: Community suicide surveillance system | N = 13
Mean age: 14.3 (SD: 2.2)
Gender: 8% male | New Hope, a brief psycho-education intervention for American Indian adolescents
Length: 1-2 visits (2-4 h total).
Developed by: Study authors
Delivered by: Community Mental Health Workers | Adequately powered: No
Outcome assessor blinding: NA
Less than 15% drop-out rate: No (15.4%)
Use of statistical testing to measure change from pre-test to post-test: Yes | SI: SIQ
Longest follow-up: 3 months post-intervention | SI: N (%) scoring above clinical cut-off; Pre-test: 7/11 (64%)
Post-test: 1/10 (10%) | (continued on next page)
<table>
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<tr>
<th>Study; country</th>
<th>Study design; level of evidence</th>
<th>Target population</th>
<th>Participants</th>
<th>Intervention description</th>
<th>Comparison condition</th>
<th>Risk of bias</th>
<th>Suicide related outcome(s) assessed; Longest follow-up</th>
<th>Results</th>
<th>Interpretation</th>
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<tr>
<td>Diamond et al. (2013) [83] USA</td>
<td>Study design: Pre-test/post-test case series Level of evidence: IV</td>
<td>Inclusion: LGB discharged from hospital with SI (admitted for SI or SA); Exclusion: Psychosis or ID Recruited from: Hospital/ED</td>
<td>N = 10 Mean age: 15.1 (SD: 1.37; Range: 14–18) Gender: 20% male</td>
<td>Attachment-based family therapy adapted for use with suicidal LGB youth. ABFT-LGB</td>
<td>Length: 12 x weekly sessions (range = 8–16). Sessions lasted for 60-min &amp; sessions 3–5 were for parents only. Developed by: Study authors Delivered by: A MH professional</td>
<td>Adequately powered: No Outcome assessor blinding: NA Less than 15% drop-out rate: Yes (0.0%) Use of statistical testing to measure change from pre-test to post-test: Yes</td>
<td>SI: Pre-test Mean (SD): 51.00 (13.00) Post-test Mean (SD): 6.88 (7.34) Longest follow-up: Post-intervention only</td>
<td>There was evidence of a significant reduction in SI between baseline and the 3-month post-intervention assessment (F-test = 18.78, p = 0.001, Cohen’s d = 0.21).</td>
<td></td>
</tr>
<tr>
<td>Duarte-Velez et al. (2016) Puerto Rico</td>
<td>Study design: Pre-test/post-test case series Level of evidence: IV</td>
<td>Inclusion: Admitted to ED with SI or SA, hospitalized, stabilized and referred to outpatient; legal guardian. Exclusion: Psychosis; developmental disorder; ID; already receiving psychotherapy; involvement in a legal procedure that would require psychological care mandated by the judicial system Recruited from: Hospital/ED</td>
<td>N = 11 Mean age: 15.36 (SD-NR; Range: 13–17) Gender: 45% male</td>
<td>Cognitive behavioral therapy adapted for Puerto Rican adolescents with suicidal behavior.</td>
<td>Length: Weekly individual sessions lasting for 1 h &amp; delivered over 6 months. Plus 60–120 min family sessions &amp; follow-up bi-weekly as necessary. Phone calls &amp; case management as needed. Developed by: Study authors Delivered by: A MH professional</td>
<td>Adequately powered: No Outcome assessor blinding: NA Less than 15% drop-out rate: No (27.3%) Use of statistical testing to measure change from pre-test to post-test: Yes</td>
<td>SI: Pre-test Mean (SD): 27.20 (NR) Post-test Mean (SD): 16.00 (NR) Longest follow-up: Post-intervention only</td>
<td>There was evidence of a reduction in SI between baseline and the six month post-intervention assessment (significance test not reported).</td>
<td></td>
</tr>
<tr>
<td>Esposito-Smythers et al. (2006) USA</td>
<td>Study design: Pre-test/post-test case series Level of evidence: IV</td>
<td>Inclusion: Admitted to inpatient unit for SI/SA with co-occurring alcohol abuse/dependence; Exclusion: ID, DSM-IV dependence on substances other than alcohol or cannabis. Recruited from: Hospital/ED</td>
<td>N = 6 Mean age: 15 (SD: 1; Range: 14–16) Gender: 17% male</td>
<td>Integrated cognitive behavioral therapy for adolescents with co-occurring alcohol use disorder and suicidality.</td>
<td>Length: Acute phase: Weekly sessions lasting 1 h &amp; delivered over 6 months (plus maintenance &amp; booster phases). Developed by: Study authors, incorporating modifications of Monti’s (2002)3 coping skills training package for youth with co-occurring alcohol use disorder. Delivered by: A MH professional</td>
<td>Adequately powered: No Outcome assessor blinding: NA Less than 15% drop-out rate: No (16.7%) Use of statistical testing to measure change from pre-test to post-test: No</td>
<td>SI: Pre-test Mean (SD): 80.80 (NR) Post-test Mean (SD): 32.80 (NR) Longest follow-up: 12 months post-intervention</td>
<td>There was evidence of a reduction in SI between baseline and the 12 month post-intervention assessment (significance test not reported). Two young people re-engaged in SRB during this period (significance test not reported).</td>
<td></td>
</tr>
<tr>
<td>Geddes et al. (2013) Australia</td>
<td>Study design: Pre-test/post-test case series Level of evidence: IV</td>
<td>Inclusion: At least 3 BPD features &amp; SI/SH in past 12 months; Exclusion: Primary diagnosis of psychosis or substance abuse; ID Recruited from: MH Outpatient</td>
<td>N = 6 Mean age: 15.1 (SD-NR; Range 14–15) Gender: 0% male</td>
<td>Integrated cognitive behavioral therapy modified for adolescents: Life Surfing</td>
<td>Length: 1–2 weeks in groups delivered over 26 weeks. Plus a weekly 2 h family skills group delivered over an 18-week period. Developed by: Based on Swales (2000) but adapted by the study authors. Delivered by: NR</td>
<td>Adequately powered: No Outcome assessor blinding: NA Less than 15% drop-out rate: No (16.7% by the three-month follow-up period) Use of statistical testing to measure change from pre-test to post-test: Yes</td>
<td>SI: NR SBR: Self-Harm/Suicidal Thoughts Questionnaire: Parent and Adolescent Versions. SA: NR Longest follow-up: 12 months post-baseline</td>
<td>There was evidence of a reduction in the proportion of young people reporting SI between baseline and the 18-week post-intervention assessment (significance test not reported). By the 18-week post-intervention assessment, 5 of the 6 young people had had no further episodes of SRB, whilst the sixth reported a 50% reduction in SRB frequency (significance tests not provided). By the 12 month follow-up</td>
<td></td>
</tr>
</tbody>
</table>
Gutstein & Rudd (1990) [78] USA

Study design: Pre-test/post-test case series
Level of evidence: IV

Inclusion: Referred to a guidance center following a near-lethal SA/persistent suicide threats (severe risk)
Exclusion: NA

N = 47
Mean age: 14.4 (SD-NR; Range: 7–19)
Gender: 47% male

A suicide-specific intensive group crisis intervention: Systemic Crisis Intervention Program
Length: Two × 4-hour group meetings over a 2–6 week period. Developed by: Study authors
Delivered by: NR

Adequately powered: No
Outcome assessor blinding: NA
Less than 15% drop-out rate: Yes (0.0%)
Use of statistical testing to measure change from pre-test to post-test: No

SA: Parental report
SA: NR

Post-intervention
No
Outcome assessor

Longest follow-up: Post-intervention only

SA: NR

There was evidence of a reduction in the proportion of young people engaging in SA between baseline and the 18 month follow-up assessment (significance test not reported).

James et al. (2011) [79] UK

Study design: Pre-test/post-test case series
Level of evidence: IV

Inclusion: Living in ‘out of home care’ & engaged in SH for >6 months
Exclusion: diagnosis of schizophrenia, bipolar disorder, autism spectrum disorder; Moderate–severe mental impairment
Recruited from: MH outpatient & community

N = 25
Mean age: 15.5 SD: 1.5; Range: 13–17
Gender: 12% male

Dialectical behavior therapy comprising a skills training group, individual therapy, telephone support, support for schools/carers & outreach.
Length: 1-hour individual sessions plus 2-hour group sessions delivered weekly over 12 months. Developed by: Based on Linehan (1993) and Rathus and Miller (2002) but adapted by the study authors.
Delivered by: A MH professional

Adequately powered: No
Outcome assessor blinding: NA
Less than 15% drop-out rate: No (28.0%)
Use of statistical testing to measure change from pre-test to post-test: Yes

SRB: Clinical interview
SRB: NR

There was evidence of a reduction in the proportion of young people engaging in SRB between baseline and the 12 week post-intervention period (14/18 young people had ceased engaging in SRB altogether) (significance tests not provided).

There was also evidence of a reduction in the frequency of these SRB episodes over this period (significance tests not provided).

James et al. (2015) [80] UK

Study design: Pre-test/post-test case series
Level of evidence: IV

Inclusion: SH in past 12 months
Exclusion: NR
Recruited from: MH outpatient & community

N = 154
Mean age: 14.9 (SD: 1.3; Range: 12–18)
Gender: 14.85% male

Dialectical behavior therapy for adolescents Length: Three-hour group sessions delivered twice weekly, plus weekly individual or family sessions, 30–60 min in duration. Delivered over 16 weeks.
Developed by: Based on Miller (2006)
Delivered by: MH professional

Adequately powered: NR
Outcome assessor blinding: NA
Less than 15% drop-out rate: No (30.3%)
Use of statistical testing to measure change from pre-test to post-test: Yes

SRB: Youth Outcome Questionnaire, Self-Report, version 2.0, item 21
Longest follow-up: Post-intervention only

SRB: Pre-test Mean (SD): 2.06 (1.68), Post-test Mean (SD): 0.65 (0.98),

There was evidence of a significant reduction in SRB between baseline and the 16-week post-intervention assessment (F-test = 68.83, p < 0.001, r² = 0.42).

Katz et al. (2004) [84] Canada

Study design: Non-randomized, experimental trial
Level of evidence: III-2

Inclusion: Admitted to Inpatient unit for SA or SI
Exclusion: ID, severe learning disability, psychosis, bipolar disorder
Recruited from: Hospital/ED

Whole sample
N = 62
Mean age: 15.4 (Range: 14–17)
Gender: 16.1% male Treatment group
N = 31 Age/gender: NR
Control group
N = 31 Age/gender: NR

Individual & group dialectical behavior therapy
Length: 10 daily group sessions plus 4 individual sessions delivered over 2 weeks.
Developed by: Based on Miller (1997) but adapted by the study authors
Delivered by: MH professional

TAU: daily psychodynamic psychotherapy group, weekly individual therapy, and psychodynamically-oriented milieu.

Adequately powered: Study authors provide power calculations, however, study unlikely to be adequately powered for SRB. Outcome assessor blinding: NA
Less than 15% drop-out rate: Yes (10.0%)
Use of statistical testing to measure change from pre-test to post-test: Yes

SI: SIQ-JR
Suicide: NR
Longest follow-up: 1 year post-intervention


Suicide: NR

There was no evidence of a reduction in SI between the intervention and control groups at post-intervention (40.90 ± 24.73 vs. 37.97 ± 24.56) and at the 12 month follow-up assessment (18.15 ± 12.52 vs. 19.35 ± 17.89). There were no completed suicides in either group by the 12 month follow-up assessment (significance test not reported).

King et al. (2003) [81] Australia

Study design: Pre-test/post-test case series
Level of evidence: IV

Inclusion: Called helpline and reported SI
Exclusion: None
Recruited from: Telephone helpline

N = 101
Age: NR
Gender: Unclear

Kids helpline
Single crisis phone call
Length: Mean duration 40 min; range 10–120 min
Developed by: Charitable organization
Delivered by: trained volunteers

Adequately powered: NR
Outcome assessor blinding: NA
Less than 15% drop-out rate: Yes (0.0%)
Use of statistical testing to measure change from pre-test to post-test: Yes

SI: Idiosyncratic, binary-coded instrument adapted from items from the Mini International Neuropsychiatric Interview.

SI: Pre-test Mean (SD): 6.30 (2.22), Post-test Mean (SD): 3.01 (2.43),

There was evidence of a significant reduction in SI from the beginning to the end of the call (average call duration 40 min) (t-test = 12.66, p < 0.005, r² = 0.62).

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<tr>
<th>Study; country</th>
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<th>Target population</th>
<th>Participants</th>
<th>Intervention description</th>
<th>Comparison condition</th>
<th>Risk of bias</th>
<th>Suicide related outcome(s) assessed; Longest follow-up</th>
<th>Results</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Law et al. (2016) Hong Kong</td>
<td>Study design: Non-randomized, experimental trial Level of evidence: III-2</td>
<td>Inclusion: Admitted to the ED with SH Exclusion: any DSM IV-TR Axis II disorder; psychosis; bipolar disorder Recruited from: Hospital/ED</td>
<td>Whole sample N = 78 Mean age: NR Range: 18–34 Gender: NR Treatment group N = 40 Mean age: 24.7 (SD: 5.4) Gender: 18.4% male Control group N = 38 Mean age: 26.0 (SD: 6.2) Gender: 11.1% male</td>
<td>Brief contact intervention: Volunteer mentorship Length: ≤2 contacts per month over 9 months. Developed by: Study authors Delivered by: trained volunteers supervised by psychiatrists, psychologists, and social workers</td>
<td>TAU (not described)</td>
<td>Adequately powered: Study authors provide power calculations, however, study unlikely to be adequately powered for SRB Outcome assessor: (NA). Less than 15% drop-out rate: No (67.8%). Use of statistical testing to measure change from pre-test to post-test: Yes</td>
<td></td>
<td>There was no evidence of a significant reduction in SI between the intervention and control groups at post-intervention (20.70 ± 3.00 vs. 15.60 ± 6.50, t = 2.31, SE = 2.52, p = 0.05). There was also no evidence of a reduction in SRB between the intervention and control groups by this time point (4/38 vs. 4/36) (significance test not provided).</td>
<td></td>
</tr>
<tr>
<td>Oldershaw et al. (2012) UK</td>
<td>Study design: Retrospective cohort study Level of evidence: III-2</td>
<td>Inclusion: Reported history of SH Exclusion: ID; serious head injury; used medication with sedative side effects; primary diagnosis not depression or SH. Recruited from: MH outpatient, schools &amp; personal contacts</td>
<td>Whole sample N = 33 Mean age: NR (SD: NR; Range: 12–18) Gender: NR Treatment group N = 24 Age: NR Gender: 4.2% male Control group N = 9 Age: NR Gender: 22.2% male</td>
<td>Standalone, formulation based, and modularized cognitive behavioral therapy with core and optional modules, depending on clinical need. Length: 12 sessions Developed by: Study authors Delivered by: MH professional</td>
<td>No treatment: Participants either declined or did not pursue treatment</td>
<td>Adequately powered: No Outcome assessor: (NA). Less than 15% drop-out rate: Yes (0.0%). Use of statistical testing to measure change from pre-test to post-test: Yes</td>
<td></td>
<td>There was evidence of a significant reduction in the proportion of participants engaging in SRB between the intervention and control groups at post-intervention (14/24 vs. 3/9). There was also evidence of a significant reduction in the frequency of SRB by this time point (Z = −3.20, p &lt; 0.001).</td>
<td></td>
</tr>
<tr>
<td>Perera Ramani &amp; Kathriarachchi, (2011) Sri Lanka</td>
<td>Study design: Non-randomized, experimental trial Level of evidence: III-2</td>
<td>Inclusion: Admitted to hospital for SA; categorized as medium- and low-intent Exclusion: Diagnosed with major psychiatric disorder Recruited from: Hospital/ED</td>
<td>Whole sample N = 124 Mean age: NR (SD: NR; Range: 15–24) Gender: Unclear Treatment group N = 62 Age/Gender: NR Control group N = 62 Age/Gender: NR</td>
<td>Individual problem solving therapy Length: 4 sessions delivered over 1 month Developed by: Based on Palmer (1995)^3 Delivered by: MH professional</td>
<td>TAU: routine care (referral to a medical officer, psychiatric referral, referrals to other agencies).</td>
<td>Adequately powered: No Outcome assessor: (NA). Less than 15% drop-out rate: No (18.3%). Use of statistical testing to measure change from pre-test to post-test: No</td>
<td></td>
<td>There was a reduction in the proportion of participants engaging in SA between the intervention and control groups at post-intervention (0/55 vs. 2/46) (significance test not reported).</td>
<td></td>
</tr>
<tr>
<td>Ratush &amp; Miller, (2002) USA</td>
<td>Study design: Non-randomized, experimental trial Level of evidence: III-2</td>
<td>Inclusion: SA or SI in past 4 months AND Personality Disorder features Exclusion: NR Recruited from: MH outpatient</td>
<td>Whole sample N = 111 Mean age: NR Gender: 21.6% male Treatment group N = 29 Mean age: 16.1 (SD: 1.2; Range: NR) Gender: 7% male Control group N = 82 Mean age: 15.0 (SD: 1.0; Range: NR)</td>
<td>Dialectical behavior therapy adapted for adolescents. Length: Two sessions per week for 12 weeks Developed by: Based on Linehan (1993) but adapted for adolescents by study authors Delivered by: MH professional</td>
<td>Active placebo: Short term psychodynamic or supportive approach aimed at resolving acute problems.</td>
<td>Adequately powered: No Outcome assessor: (NA). Less than 15% drop-out rate: Unknown Use of statistical testing to measure change from pre-test to post-test: Yes</td>
<td></td>
<td>There was a significant reduction in SI between baseline and the 12-week post-intervention assessment (t-test = 2.65, p = 0.026). There was also evidence of a reduction in SA between the intervention and control groups by the 12-week post-intervention assessment (1.29 vs. 7.82).</td>
<td></td>
</tr>
</tbody>
</table>
Rotheram-Borus et al. (1996)

**Study design:** Historical controlled study  
**Level of evidence:** III-3

**Inclusion:** Presented to ED with SA & hospitalized for <1 week  
**Exclusion:** Low IQ, no parent or family  
**Recruited from:** Hospital/ED

- **Whole sample:** N = 140  
  - Mean age: 15.0 (SD: NR; Range: 12–18)  
  - Gender: 27% male  

- **Treatment group:**  
  - N = 65  
  - Mean age: 15.0 (SD: 1.4)  
  - Gender: 27% male  

- **Control group:**  
  - N = 75  
  - Mean age: 15.0 (SD: 1.4)  
  - Gender: 27% male

**Treatment:** Specialized Emergency Room Program: Comprised 1 family psychotherapy session plus psycho-education video.  
**Length:** Session = NR; video = 20 min  
**Developed by:** Study authors  
**Delivered by:** MH professional

**TAU:** evaluation to determine if hospitalization required & referral to outpatient therapy.  
**Adequately powered:** Likely to be adequately powered for SI  
**Outcome assessor blinding:** NA  
**Less than 15% dropout rate:** Yes (0.0%)  
**Use of statistical testing to measure change from pre-test to post-test:** Yes

**SI:** Harkavy-Asnis Suicide Survey, passive suicidal ideation subscale  
**SA:** Self- and parental-report in conjunction with hospital records  
**Longest follow-up:** 18 months post-suicide attempt

**Notes:** ED = Emergency Department; ID = Intellectual Disability; ITT = intention-to-treat; IQR = Interquartile Range; MH = mental health; NR = not reported; TAU = treatment as usual; SA = suicide attempt; SD = standard deviation; SH = self-harm; SI = suicidal ideation; SRB = suicide-related behavior.

Wharff et al. (2012)

**Study design:** Historical controlled study  
**Level of evidence:** III-3

**Inclusion:** Presented to the ED with SRB  
**Exclusion:** not living with family; presented to ED without a family member; intoxicated/sedated at time of presentation; psychosis or developmental delay; presented during overnight shift or on weekend  
**Recruited from:** Hospital/ED

- **Whole sample:** N = 250  
  - Mean age: NR (SD: NR; Range: 13–18)  
  - Gender: 29% male  

- **Treatment group:**  
  - N = 100  
  - Mean age: 15.6 (SD: 1.5)  
  - Gender: 24% male

- **Control group:**  
  - N = 150  
  - Age: NR  
  - Gender: 26% male

**One session of family based crisis intervention**  
**Developed by:** Study authors  
**Delivered by:** MH professional

**TAU:** retrospective comparison group who presented to the same ER prior to intervention of FBCI  
**Adequately powered:** Not adequate  
**Outcome assessor blinding:** Unclear  
**Less than 15% dropout rate:** No (44.6%)  
**Use of statistical testing to measure change from pre-test to post-test:** No

**SI:** Post-intervention: Intervention mean (SD): 1.40 (2.38)  
**SA:** Post-intervention: Tx – 6/65 participants reattempted; Control – 11/75 participants reattempted

**Notes:** ED = Emergency Department; ID = Intellectual Disability; ITT = intention-to-treat; IQR = Interquartile Range; MH = mental health; NR = not reported; TAU = treatment as usual; SA = suicide attempt; SD = standard deviation; SH = self-harm; SI = suicidal ideation; SRB = suicide-related behavior.

There was evidence of a significant reduction in SI between the intervention and control groups by the post-intervention assessment (p < 0.001). There was also evidence of a reduction in SA between the intervention and control groups by the 18 month follow-up assessment (significance test not reported).
### Table 3
Study characteristics: Randomized controlled trials conducted in educational or workplace settings (N = 15).

<table>
<thead>
<tr>
<th>Study country</th>
<th>Target population</th>
<th>Participants</th>
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<td>Till et al. (2017) [119] Austria</td>
<td>Inclusion: medical, psychology and communication studies undergraduate students Exclusion: None Recruited from: University (N = 1)</td>
<td>Whole sample N = 161 Mean age: 24.5 (SD: 5.8) Gender: 32.9% male Treatment group N = 121 Mean age: 24.3 (SD: NR) Gender: 33.9% male Control group N = 40 Mean age: 25.0 (SD: 6.8) Gender: 30% male</td>
<td>A website unrelated to suicide or mental health</td>
<td>Random sequence generation method: NR Allocation concealment method: NR Ascertainment of SH repetition: Self-report Outcome assessor blinding: NA Less than 15% drop-out rate: Unclear Was ITT analysis undertaken: Yes</td>
<td>SI (continuous): Reasons for Living Inventory (RFLI) Longest follow-up: Post-intervention only</td>
</tr>
</tbody>
</table>
Gender: 52.14% male  
Control group  
N = 121  
Mean age: 15.62 (SD: 1.26)  
Gender: 50.83% male

2) C-CARE plus a small group prevention program.  
Length:
1) 2-hour assessment plus one 1.5–2 h counseling;  
2) Additional 12 × 1 hour sessions over 6 weeks  
Developed by: study authors  
Delivered by: 1) Trained research staff e.g. practice nurses & social workers; 2) Teachers, counselors or nurses

Fitzpatrick et al. (2005) [115]  
USA  
Inclusion: Students who screened positive for SI  
Exclusion: students who were judged to represent an immediate threat of danger to themselves or others  
Recruited from: University (N = 1)

Whole sample  
N = 110  
Mean age: 19.02 (SD: 1.21;  
Range: 18–24)  
Gender: 45% male  
Treatment group: NR  
Control group: NR

Was ITT analysis undertaken: No

Hill & Pettit, (2016)  
[122]  
USA  
Inclusion: Endorsed a perceived burdensomeness score of 17 or greater on the Interpersonal Needs Questionnaire Perceived Burdensomeness subscale (Van Orden et al., 2012)[12]  
Exclusion: Current psychosocial treatment or use of psychoactive  
Placebo: e-mail containing psychoeducational information about mental health & suicide, and resources for mental health treatment and suicide/crisis counseling.

Was ITT analysis undertaken: Yes

Hetrick et al. (2017) [123]  
Australia  
Inclusion: Presented to school counselor with SI  
Exclusion: Intellectual disability; psychotic symptoms; inability to speak English  
Recruited from: Secondary schools (N = 18)

Whole sample  
N = 50  
Mean age: 14.7 (SD: 1.4)  
Gender: 18% male  
Treatment group  
N = 26  
Mean age: 14.8 (SD: 1.6)  
Gender: 19.3% male  
Control group  
N = 24  
Mean age: 14.5 (SD: 1.3)  
Gender: 16.7% male

Random sequence generation method: Online randomization program, stratified by school  
Allocation concealment method: The online program did not allow knowledge of treatment next to be allocated before the participant details were entered into the computer  
Ascertainment of SH repetition: Interview  
Outcome assessor blinding: NA  
Less than 15% drop-out rate: No (28.6%)  
Was ITT analysis undertaken: Yes

(continued on next page)
<table>
<thead>
<tr>
<th>Study: country</th>
<th>Target population</th>
<th>Participants</th>
<th>Intervention description</th>
<th>Comparison condition</th>
<th>Risk of bias</th>
<th>Suicide related outcome(s) assessed; longest follow-up</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kovac &amp; Range, (2002) [114] USA</td>
<td>Inclusion: Students who screened positive for SRB, Exclusion: None</td>
<td>Recruited from: University (N = 1)</td>
<td>Whole sample N = 121 Mean age: 23.12 (SD: 5.44; Range: 18 – 42) Gender: 27.3% male Treatment group N = NR Age/gender: NR Control group N = NR Placebo: Wrote in detail about their bedroom</td>
<td>A writing intervention to examine whether writing with ‘cognitive change’ reduced suicide risk when compared to writing just about suicidal experience and compared to controls. Group 1: Wrote about being suicidal &amp; were instructed to think about their thoughts and feelings at the time. Group 2: Wrote about being suicidal but were asked to provide details about the event. Group 3: Control. Length: four 20-min sessions delivered once a day for 4 days Developed by: study authors Delivered by: unclear</td>
<td>SI (continuous): SIQ</td>
<td>Longest follow-up: 6 weeks post-intervention</td>
</tr>
<tr>
<td>Pistorello et al. (2012) [116] USA</td>
<td>Inclusion: Students seeking treatment from a University mental health service for SI, SA, or NSSI, Exclusion: psychosis, need for inpatient care, or prior DBT treatment</td>
<td>Recruited from: University (N = 1)</td>
<td>Whole sample N = 63 Mean age: 20.9 (SD: 1.92) Gender: 19% male Treatment group N = 31 Mean age: 20.4 (SD: 1.6) Gender: 22.6% male Control group N = 32 Mean age: 21.3 (SD: 2.1) Gender: 15.6% male</td>
<td>A combination of individual and group dialectical behavioral therapy. Delivered by: Length: Comprised one 50-min individual psychotherapy session plus a 90-min group skills training session per week, over a 12-month period Developed by: based on Linehan, (1993) Delivered by: MH professionals</td>
<td>Enhanced TAU: included weekly individual &amp; group therapy, weekly group supervision for therapists, &amp; between-session consultation and family. Interventions as needed.</td>
<td>Random sequence generation method: Computer generated adaptive randomization Allocation concealment method: NR Ascertainment of SH repetition: Interview Outcome assessor blinding: NA Less than 15% drop-out rate at post-intervention: No (22.2%) Was ITT analysis undertaken: Yes. All participants with SI (continuous): Suicidal Behaviors Questionnaire (SBQ-23) SA: SBQ-32 Longest follow-up: 18 months post-baseline</td>
</tr>
<tr>
<td>Study</td>
<td>Country/Year</td>
<td>Inclusion</td>
<td>Exclusion</td>
<td>Recruitment</td>
<td>Sample Sizes</td>
<td>Treatment</td>
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<tr>
<td>Tang et al. (2009) [98] Taiwan</td>
<td>Students with moderate–severe depression, SI, SA, moderate–severe anxiety, or significant hopelessness in previous 2 weeks.</td>
<td>Acute psychotic symptoms, act out lethal suicidal behaviors, lack proper care for suicide risk by their family, drug abuse, or serious medication condition</td>
<td>Recruited from Secondary schools (N = 1)</td>
<td>Whole sample N = 73</td>
<td>Mean age: NR (Range: 14–18)</td>
<td>Treatment group: N = 35 Mean age: 15.26 (SD: 1.7)</td>
</tr>
<tr>
<td>Multi-modal interventions Schilling et al. (2014) [99] USA</td>
<td>Middle school students</td>
<td>None</td>
<td>Recruited from Middle schools (N = 8)</td>
<td>Whole sample N = 470</td>
<td>Age: NR</td>
<td>Treatment group: NR</td>
</tr>
</tbody>
</table>

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<thead>
<tr>
<th>Study; country</th>
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<th>Risk of bias</th>
<th>Suicide related outcome(s) assessed; longest follow-up</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wasserman et al. (2015) [101]</td>
<td>Multi-site: 10 European countries</td>
<td>Inclusion: all students in participating classrooms Exclusion: None (although students who reported suicide attempts ever, or severe suicidal ideation in the past 2 weeks before the baseline assessment, and those with missing data regarding these two variables were excluded from the final analysis) Recruited from: Secondary schools (N = 168)</td>
<td>Whole sample N = 11,110 Mean age: 14.8 (SD: 0.8) Gender: 61.6% male</td>
<td>Psycho-educational (universal) component Youth Aware of Mental Health Programme (YAM), a universal intervention that aims to raise awareness of risk &amp; protective factors associated with suicide, including knowledge of depression/anxiety and to enhance skills to manage stress, adverse life events &amp; suicidal behaviors Length: 3 h role play session plus 2 × 1 h lectures Developed by: study authors Gatekeeper training (selective) component Question, Persuade, and Refer (QPR), a gatekeeper training module targeting teachers and other school personnel Length: NR Developed by: Tompkins et al. (2010) Screening (selective) component Screening by health professionals (ProfScreen) with referral of at-risk pupils Length: NA Developed by: study authors Delivered by: Trained instructors</td>
<td>Active placebo: The control group was exposed to the same 6 educational posters as the YAM group. These included information about local health-care providers.</td>
<td>Unclear Was ITT analysis undertaken: No</td>
</tr>
</tbody>
</table>

Notes: ED = Emergency Department; ITT = intention-to-treat; IQR = Interquartile Range; MA = meta-analysis; MH = mental health; NA = not applicable; NR = not reported; TAU = treatment as usual; SA = suicide attempt; SD = standard deviation; SH = self-harm; SI = suicidal ideation; SRB = suicide-related behavior.

[104] Note: This study recruited participants from both schools and the community.
[106] Classified as BCI in the meta-analysis
<table>
<thead>
<tr>
<th>Study; country</th>
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<th>Risk of bias</th>
<th>Suicide related outcome(s) assessed</th>
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<th>Results</th>
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<tbody>
<tr>
<td>Universal interventions</td>
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<tr>
<td>Bailey et al. (2017) [110]</td>
<td>Pre-test/post-test case series</td>
<td>Level of evidence: IV</td>
<td>Inclusion: year 11 and 12 students at participating schools</td>
<td>Exclusion: None Recruited from: Secondary schools (N = 3)</td>
<td>Whole sample: N = 129</td>
<td>Mean age: 16.7 (range 16–18)</td>
<td>Gender: 53.5% male</td>
<td>Educational safeTALK</td>
<td>NA</td>
<td>Adequately powered: No</td>
</tr>
<tr>
<td>King et al. (2011) [102]</td>
<td>Pre-test/post-test case series</td>
<td>Level of evidence: IV</td>
<td>Inclusion: Students at participating schools</td>
<td>Exclusion: None Recruited from: Secondary schools (N participating = NR, but the program was implemented in 24 schools).</td>
<td>Whole sample: N = 1030</td>
<td>Mean age: 14.1 (SD: 0.79; range 14–18)</td>
<td>Gender: 43.9% male</td>
<td>Educational Surviving the Teens® Suicide Prevention and Depression Awareness Program.</td>
<td>NA</td>
<td>Adequately powered: No power calculations provided.</td>
</tr>
<tr>
<td>LaFromboise &amp; Howard-Pitney, (1995) [94]</td>
<td>Non-randomized experimental trial</td>
<td>Level of evidence: III-2</td>
<td>Inclusion: Freshman and junior students taking language arts classes at a Zuni secondary school</td>
<td>Exclusion: None Recruited from:</td>
<td>Whole sample: N = 128</td>
<td>Mean age: 15.9 (Range: 14–19)</td>
<td>Gender: 36% male</td>
<td>Educational The Zuni Life Skills Development Curriculum. Units: building self-esteem; identifying emotions &amp; stress; communication &amp; problem-solving skills; recognizing &amp; eliminating self-destructive behavior; suicide information; suicide intervention training; goal setting</td>
<td>No intervention</td>
<td>Adequately powered: No</td>
</tr>
</tbody>
</table>

(continued on next page)
There was no evidence that the program had an effect on suicide attempt rates. SA: Intervention: Yes = 2.5% Control: Yes = 2.7%

**Table 4** (continued)

<table>
<thead>
<tr>
<th>Study; country</th>
<th>Study design; level of evidence</th>
<th>Target population</th>
<th>Participants</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Virland et al. [1991] [103] USA</td>
<td>Study design: Non-randomized experimental trial Level of evidence: III-2</td>
<td>Secondary school (N = 1)</td>
<td>- group: N = 69 Age/gender: NR Control group: N = 59 Age/gender: NR</td>
<td>Length: Seven units delivered 3 times a week over approx. 30 weeks Developed by: Study authors Delivered by: Teachers</td>
<td>measure change at from pre-test to post-test: Yes</td>
<td>Unclear</td>
<td>SA: Single item asking participants to indicate whether or not they had made a first suicide attempt Longest follow-up: 18 months post-baseline</td>
<td>SA: Intervention: Yes = 2.5% Control: Yes = 2.7%</td>
<td>There was no evidence that the program had an effect on suicide attempt rates.</td>
</tr>
<tr>
<td>Hazell &amp; Lewin [1993] [104] Australia</td>
<td>Study design: Post-test case series Level of evidence: IV</td>
<td>Selective interventions</td>
<td>- Whole sample: N = 381 Mean age: 15.8 Gender: NR</td>
<td>Educational In-class presentation. Emphasized support networks in alleviating stress, confronting one’s peers, and community resources.</td>
<td>No intervention</td>
<td>Adequately powered: No Outcome assessor blinding: NA Less than 15% drop-out rate: Unclear Use of statistical testing to measure change at from pre-test to post-test: No</td>
<td>SA: Hospitalization for SA (obtained from official sources) SH: Incidence of current suicidal behavior - YSR CBCL SL: % of group currently experiencing suicidal ideation – YSR CBCL Longest follow-up: Post-intervention only</td>
<td>SA: Intervention: 1.0% Control: 0.0% SH: Intervention: 21.0% Control: 19.0% SI: Intervention: 14.5% Control group: 19.0%</td>
<td>There were no differences between groups on SA, SH or SI as assessed by Pearson X2</td>
</tr>
<tr>
<td>McDaniel et al. [1990] [121] USA</td>
<td>Study design: Interrupted time series with a control group Level of evidence: III-2</td>
<td>US Navy instructors</td>
<td>- Whole sample: N = 126 Mean age/gender: NR</td>
<td>Therapeutic One session of group counseling provided at school within 7 days of a student suicide. Following the session, school staff were debriefed &amp; arrangements made to follow-up high risk students.</td>
<td>Unclear</td>
<td>Adequately powered: NR Outcome assessor blinding: NA Less than 15% drop-out rate: Unclear Use of statistical testing to measure change at from pre-test to post-test: Yes</td>
<td>SA: Average monthly rate of SA (obtained from official sources)</td>
<td>SA: Post-test Intervention rate: 9.4 Control rate: 1.8</td>
<td>There was a declining trend in the suicide attempt rate in the intervention group. At post-test, the average monthly suicide attempt rate was significantly higher in the intervention group, p &lt; 0.001.</td>
</tr>
</tbody>
</table>
| Study design: Post-test case series  
USA | Inclusion: Students demonstrating SRB  
Exclusion: NA  
Recruited from: Secondary schools (N = 619)  
N = 18,445  
Mean age: NR  
(Range: 13–21)  
Gender: NR | Therapeutic Student Assistance Program (SAP): Identify individual student problems & recommend interventions. Participants are students referred to the SAP who accessed the recommended services.  
Length: NA  
Developed by: Commonwealth Student Assistance Program Interagency Committee, Pennsylvania.  
Delivered by: Trained school staff | No intervention | Adequately powered: Yes  
Outcome assessor: NA  
Less than 5% drop-out rate: Unclear  
Use of statistical testing to measure change at from pre-test to post-test: Unclear | Number of suicides and suicide rate per 100,000 students | Suicide: Deaths by suicide rate per 100,000 students | The difference in suicide rates was not statistically significant. |
|---|---|---|---|---|---|---|---|---|
| Study design: Post-test case series  
USA | Inclusion: Students reporting: SA; SI; moderate-serious depression; specific levels of alcohol or other drug use, polyuse, or drug control problems  
Exclusion: None  
Recruited from: Secondary schools (N = 5)  
Whole sample: N = 105  
Mean age: 16.19 (SD: 0.92)  
Gender: 41.7% male  
PGC I group: N = 36  
Mean age: 15.82 (SD: 1.11)  
Gender: 37.1% male  
Control: N = 35  
Mean age: 15.57 (SD: 1.01)  
Gender: 45.7% male | Psycho-education  
Personal growth classes (PGCs): Incorporated [1] group work; [2] weekly monitoring of activities targeting changes in mood management, school performance and attendance, and drug involvement; and [3] life skills training in self-esteem enhancement, decision making, personal control (skills training in anger, depression, and stress management), and interpersonal communication.  
Length: (PGC I): One semester - 5 months or 90 class days; (PGC II): Two semesters − 10 months or 180 class days.  
Developed by: Study authors  
Delivered by: Trained school staff | Enhanced TAU: Assessed for suicide 'potential'.  
Use of statistical testing to measure change at from pre-test to post-test: Yes | Adequately powered: NR  
Outcome assessor: NA  
Less than 5% drop-out rate: Unclear  
Use of statistical testing to measure change at from pre-test to post-test: Yes | Suicide: Number of suicides and suicide rate per 100,000 students | Suicide: Deaths by suicide rate per 100,000 students | There was no significant difference in suicide risk behaviors between the groups. There was a significant decline in suicide risk behaviors for all three groups (F Linear [1,102] = 104.14, p < 0.001) revealed a significant decline for all three groups. |
| Study design: Interrupted time series with a control group  
USA | Inclusion: Students with a SA or suicide 'threat'  
Exclusion: NA  
Recruited from: University (N = 1)  
Student population: Treatment location:  
1980–1983: 139,384  
1984–1990: 249,812  
Control location:  
1980–1983: 1,244,469  
1984–1990: 1,807,968 | Policy  
Implementation of a policy requiring any student who made a suicide threat or attempt to receive 4 individual sessions of professional assessment, the first which occurred within a week of the incident.  
Length: NR  
Developed by: Counseling Center, University of Illinois  
Delivered by: MH professionals | Data collected from 11 other universities | Adequately powered: NR  
Outcome assessor: NA  
Less than 5% drop-out rate: Not Reported  
Use of statistical testing to measure change at from pre-test to post-test: Yes | Suicide: Deaths by suicide rate per 100,000 enrolled students per year | Suicide: Post-test Intervention N (rate): 2.0  
Control N (rate): 8.68 | The treatment group had a 74.7% reduction in the suicide rate, compared to an increasing suicide rate in the comparison group, z score = 5.90, p < 0.05 |
| Study design: Non-randomized, experimental trial  
USA | Inclusion: Students with SI  
Exclusion: Psychosis, substance abuse  
Whole sample: N = 18  
Mean age: 19.17 (SD: 7) | Therapeutic group problem solving therapy  
Length: 10 sessions over 5–7 weeks  
Developed by: Based on D'Zurilla and Goldfried (1971)  
Active placebo: Empathetic listening, sharing experiences with the group. | Adequately powered: No  
Outcome assessor: NA  
Less than 15% | Suicide: Number of suicides and suicide rate per 100,000 students | Suicide: Post-test Intervention Mean (SD): 5.8  
Control mean (7.0) | There was no significant difference in suicidal ideation between the groups at both time points (T2: F value < 1; T3: F value = 1.87) | (continued on next page)
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<tr>
<th>Study; country</th>
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<th>Target population</th>
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<th>Intervention description</th>
<th>Comparison condition</th>
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<th>Suicide related outcome(s) assessed; Longest follow-up</th>
<th>Results</th>
<th>Interpretation</th>
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</thead>
<tbody>
<tr>
<td>Robinson J et al. (2016) [112], Australia</td>
<td>Study design: Pre-test/post-test case series; Level of evidence: IV</td>
<td>Inclusion: Students who presented to the school counselor with SI in the past month</td>
<td>Whole sample: N = 32</td>
<td>Delivered by: MH professional</td>
<td>drop-out rate: Yes (0.0%)</td>
<td>Use of statistical testing to measure change at from pre-test to post-test: Yes</td>
<td>(SD): 5.3 (9.2) 3-month follow-up</td>
<td>Intervention mean (SD): 4.7 (3.4) Control mean (SD): 10.6 (8.8)</td>
<td></td>
</tr>
<tr>
<td>Multi-modal interventions</td>
<td>Aseltine et al. (2007) [107], USA</td>
<td>Study design: Pseudo-RCT; Level of evidence: III-1</td>
<td>Inclusion: Students at participating schools</td>
<td>Therapeutic Reframe-IT.</td>
<td>Adequately powered: No</td>
<td>SI: Pre-test Mean (SD): 3.2 (1.6) Post-test Mean (SD): 1.5 (1.3)</td>
<td>There was a statistically significant decrease in SI from pre to post-test, with a moderate effect size, t = 6.2; p &lt; 0.0005</td>
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<tr>
<td>Shelef et al. (2016) [120], Israel</td>
<td>Study design: Interrupted time series with a secondary sample</td>
<td>Inclusion: Active duty mandatory service military</td>
<td>Whole sample: N = 1,171,359</td>
<td>Psycho-education &amp; screening Signs of Suicide (SOS); Universal educational component: Video &amp; discussion guide depicting signs of suicidality &amp; depression and recommended ways to respond. Selective component: Screening to identify students at risk.</td>
<td>Adequately powered: No</td>
<td>Suicide: Pre-intervention (2006–2012): N</td>
<td>Trend analysis showed lower suicide rates in the cohort after intervention, Hazard ratio = 0.48 (95%CI:</td>
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<tr>
<td>Level of evidence</td>
<td>Study design</td>
<td>Case series</td>
<td>Inclusion</td>
<td>Exclusion</td>
<td>Recruitment</td>
<td>Control group</td>
<td>Treatment group</td>
<td>Implementation of intervention</td>
<td>Outcome assessment</td>
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<tr>
<td>III–2</td>
<td>Pre-test/post-test</td>
<td>Secondary students in Miami, Florida</td>
<td>All secondary school students</td>
<td>NA</td>
<td>Recruited from: Secondary schools (N = 300)</td>
<td>N = 3244; Mean age: 15.45 years</td>
<td>N = 344; Mean age: 15.45 years</td>
<td>NA</td>
<td>No</td>
</tr>
<tr>
<td>IV</td>
<td>Interrupted time series without a control group</td>
<td>Secondary students in Canada</td>
<td>All secondary school students with SI (with or without SA)</td>
<td>None</td>
<td>Recruited from: Secondary schools</td>
<td>N = 3244; Mean age: 15.45 years</td>
<td>N = 344; Mean age: 15.45 years</td>
<td>NA</td>
<td>No</td>
</tr>
</tbody>
</table>

Notes: ED = Emergency Department; ID = Intellectual Disability; ITT = intention-to-treat; IQR = Interquartile Range; MH = mental health; NA = not applicable; NR = not reported; TAU = treatment as usual; SA = suicide attempt; SD = standard deviation; SH = self-harm; SI = suicidal ideation; SRR = suicide-related behavior.

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<thead>
<tr>
<th>Study: county</th>
<th>Study design; level of evidence</th>
<th>Target region/population; comparison</th>
<th>Intervention description</th>
<th>Time period</th>
<th>Risk of bias</th>
<th>Outcome/data source</th>
<th>Rates per 100,000</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Universal: means restriction</td>
<td>Study design: Interrupted time series without a control group</td>
<td>Level of evidence: III-3</td>
<td>Firearms legislation introduced in 1992 mandating license to own a firearm.</td>
<td>1985–1992: pre-legislation; 1993–1996: implementation; 1997–2002: post-implementation.</td>
<td>Were data collected at multiple time points? Yes</td>
<td>Suicide: Mean annual age-specific suicide rates by all methods and by firearm for persons aged 15–24 years, obtained through New Zealand Health Information Service (NZHIS)</td>
<td>Suicide: All: Unclear</td>
<td>Firearm: Unclear</td>
</tr>
<tr>
<td>New Zealand</td>
<td>Target region/population: NA</td>
<td>Comparison: None</td>
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<tr>
<td>Caron (2004) [126] Canada</td>
<td>Study design: Interrupted time series without a control group</td>
<td>Level of evidence: III-3</td>
<td>Firearms legislation introduced in 1992 mandating firearm owners to safely store their firearms.</td>
<td>1986–1991: pre-legislation; 1992–1996: post-legislation.</td>
<td>Were data collected at multiple time points? Yes</td>
<td>Suicide: Age-specific suicide rates by all methods and by firearm for under 25 age group obtained through the Quebec Coroner’s office.</td>
<td>Suicide: All: NR</td>
<td>Firearm: NR</td>
</tr>
<tr>
<td>Leenaars &amp; Lester (1997) [130] Canada</td>
<td>Study design: Interrupted time series without a control group</td>
<td>Level of evidence: III-3</td>
<td>Gun control legislation introduced in 1977 (Bill C-51).</td>
<td>1969–1976: pre-legislation; 1978–1986: post-legislation.</td>
<td></td>
<td>Suicide: Suicides rates by firearm and by all methods, and percentage of total suicide rate by firearm, in persons aged 15–24, obtained from Statistics Canada and supplemented by personal communications.</td>
<td>Suicide: All: Pre-Legislation: 12.57 Post-Legislation: 16.11</td>
<td>Firearm: Pre-Legislation: 5.89 Post-Legislation: 7.12</td>
</tr>
<tr>
<td></td>
<td>Target region/population: NA</td>
<td>Comparison: None</td>
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</tbody>
</table>
Multi-modal
Ahmadi & Ytterstad
(2007) [124]
Iran
Study design:
Interrupted time series with a control group
Target region/population:
Young women and low SES in 2 cities
Comparison: None
Level of evidence: III-2
Multi-modal: mix of passive and active strategies (not described). Key feature was psycho-education via videos
Pre-intervention - 1999–2000
Intervention - 2000–2003
Were data collected at multiple time points? No
Were the intervention likely to affect data collection? Yes: Possible that those involved in data collection were not blinded to the intervention (suicide attempts).
SH: N (%) of total self-inflicted burn cases who was admitted in Gilangharb and Sarpozlazhab hospitals during the baseline year to the study, during the study period, and the last year of the study period in persons aged 0–20 years.
SH: NR
No statistical analyses were performed on rates of self-immolation in youth.

Center for Disease Control
Control (1998)
USA
Study design:
Interrupted time series without a control group
Target region/population:
Western Athabaskan tribe in rural New Mexico, USA
Comparison: None
Level of evidence: III-3
Multi-modal: gatekeeper training, outreach to families, immediate response and follow up for reported at-risk youth, community psychoeducation, and screening in services.
Were data collected at multiple time points? Yes
Were the intervention likely to affect data collection? Yes: It is possible that those involved in data collection were not blinded to the intervention (suicide attempts). This was a not a problem with suicide deaths as this was obtained from official sources.
SRB: Rates of suicide acts for persons aged 15–19 (included completions and attempts) obtained via a surveillance form.
SRB: 1988–1989: 59.8
1990–1991: 8.9
1994–1995: 17.6
1996–1999: 10.9
Although rates varied after implementation of the program, they remained substantially lower than before the program was initiated.

Cwik et al. (2016)
USA
Study design:
Interrupted time series without a control group
Target region/population:
Apache Indians
Comparison: None
Level of evidence: III-3
Multi-modal: implemented in 2006, included psychoeducation for students, gatekeeper training, and indicated interventions for suicidal young people.
Were data collected at multiple time points? Yes
Were the intervention likely to affect data collection? Yes: It is possible that those involved in data collection were not blinded to the intervention (suicide attempts).
Were data collected at multiple time points? Yes
Suicide: Suicide rates for persons aged 10–24 years, obtained via The Celebrating Life surveillance system (established by tribal resolution in 2001).
Suicide: Pre-test: 10–14 years: 17.1
15–19 years: 23.6
20–24 years: 151.9
Post-test: 10–14 years: 23.6
15–19 years: 101.9
20–24 years: 96.0
Overall the data indicates a decrease in the rate of suicide and suicide attempts (significance = NR).

Hacker et al. (2008)
USA
Study design:
Interrupted time series without a control group
Target region/population:
Somerville, MA, USA
Comparison: Massachusetts
Level of evidence: III-3
Multi-modal: implemented between 2003 and 2005, included local trauma response network, community wide vigil, school based counseling, hospital beds made available, outreach to suicide survivors to offer services, youth leadership programs, media reporting guidelines, community-wide education.
Were data collected at multiple time points? Yes
Were the intervention likely to affect data collection? Yes: Data collection from official sources.
SA/SH: 2005 Somerville: 47.3 Massachusetts: 73.7 2006 Somerville: 53.2 Massachusetts: 74.8
The suicide rate increased by 38% in 10–14 year-olds, and decreased by 5.5% in 15–19 year-olds and 36.8% in 20–24 year-olds.

(continued on next page)
<table>
<thead>
<tr>
<th>Study; country</th>
<th>Study design; level of evidence</th>
<th>Target region/population; comparison</th>
<th>Intervention description</th>
<th>Time period</th>
<th>Risk of bias</th>
<th>Outcome/data source</th>
<th>Rates per 100,000</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>May et al. (2005) [134] USA</td>
<td>Study design: Interrupted time series without a control group</td>
<td>Target region/population: Western Athabaskan Tribal Nation. New Mexico, USA</td>
<td>Multi-modal: Surveillance, screening/clinical interventions with extensive outreach in multiple settings, school-based prevention programs, community education for adults and youths, training of ‘natural helpers.’</td>
<td>Baseline - 1988–1989; then two yearly numbers and yearly averages until 2002</td>
<td>Were data collected at multiple time points? Yes</td>
<td>Suicide: 20.901 (mean total rate)</td>
<td>Suicide attempts: Counties implementing GLS program activities had significantly lower suicide attempt rates among youths 16 to 23 years of age in the year following implementation of the GLS program than did similar counties that did not implement GLS program activities (4.9 fewer attempts per 1000 youths [95%CI, 1.8–8.0 fewer attempts per 1000 youths]; p = 0.003). No evidence of an effect beyond one year after training implementation. Suicide deaths: Counties implementing GLS training had significantly lower suicide rates among the population aged 10–24 years in the year after GLS training than similar counties that did not implement GLS training (1.33 fewer deaths per 100,000; p = 0.02). No evidence of an effect beyond one year after training implementation. Suicide attempts: Counties implementing GLS program activities had significantly lower suicide attempt rates among youths 16 to 23 years of age in the year following implementation of the GLS program than did similar counties that did not implement GLS program activities (4.9 fewer attempts per 1000 youths [95%CI, 1.8–8.0 fewer attempts per 1000 youths]; p = 0.003). No evidence of an effect beyond one year after training implementation. Suicide deaths: Counties implementing GLS program activities had significantly lower suicide rates among the population aged 10–24 years in the year after GLS training than similar counties that did not implement GLS training (1.33 fewer deaths per 100,000; p = 0.02). No evidence of an effect beyond one year after training implementation.</td>
<td></td>
</tr>
<tr>
<td>Multiple interventions Garraza et al. (2015) [139; Walrath et al. (2015) [38] USA</td>
<td>Study design: Ecological</td>
<td>Target region/population: 466 counties, USA</td>
<td>Multiple: Activities funded by the Garrett Lee Smith (GLS) Memorial Suicide Prevention Program, implemented between 2006 and 2009. Includes gatekeeper training, psychoeducation programs, screening, improved community partnerships and linkages to service, postvention programs, and crisis hotlines.</td>
<td>At least 1 NSDUH respondent between 2008 and 2011, suicide mortality between 2007 and 2010</td>
<td>Were data collected at multiple time points? No</td>
<td>Suicide: suicide rates for persons aged 10–24 years between 2007 and 2010, obtained from the National Vital Statistics System.</td>
<td>Suicide: Suicide rates for persons aged 10–24 years between 2007 and 2010, obtained from the National Vital Statistics System.</td>
<td>There was a significant decline in the number of combined gestures and attempts in 19–24 year-olds (coeff = −765, p = 0.001) and 11 to 18 year-olds (coeff = −0.517, p = 0.048).</td>
</tr>
<tr>
<td>Matsushayashi &amp; Ueda (2011) [133] Multi-national</td>
<td>Study design: Interrupted time series with a control group</td>
<td>Target region/population: 21 OECD nations</td>
<td>Multiple: National prevention programs - specific interventions not specified or analyzed.</td>
<td>1980–2004 One time period, statistical models include date of implementation of suicide prevention program - varies for each country</td>
<td>Were data collected at multiple time points? No</td>
<td>Suicide rates in under 25 year-olds, obtained via the WHO mortality database</td>
<td>Suicide: 20.901 (mean total rate)</td>
<td>There was a significant decline in the number of combined gestures and attempts in 19–24 year-olds (coeff = −765, p = 0.001) and 11 to 18 year-olds (coeff = −0.517, p = 0.048).</td>
</tr>
</tbody>
</table>

Notes: NSDUH = National Survey on Drug Use and Health; NA = not applicable; NR = not reported; OECD = Organization for Economic Co-operation and Development; WHO = World Health Organization; SA = suicide attempt; SE = standard error; SES = socio-economic status; SH = self-harm; SI = suicidal ideation; SRB = suicide-related behavior.

* Defined as at least twice before or at least twice after implementation of the intervention.

* Note: it is likely that this study is a subset of the date included in Wheeler et al (2009).
One RCT in this category was not included in the meta-analysis. This investigated the impact of Parent-Adolescent CBT [72]; authors reported reduced suicidal ideation in both groups during active and maintenance treatment and at follow-up.

### 3.3.1.3. Study Quality
The majority of these studies used random sequence generation [40–51,53–56,58,59,61,62,64–71] (k = 28; 84.8%) and 21 (60.6%) used adequate allocation concealment strategies [42–46,49–51,53–55,58,59,61,62,64–67,69,70]. Of the 25 studies that assessed outcomes via interview, 13 (52.0%) reported assessor blinding [43–45,49,51,53,55,56,59,61,64,66,65,70]. Thirteen studies reported conducting intention-to-treat (ITT) analysis [42,46,48,53,56,58,59,61,64,65,69,72]. One study did not use ITT, but conducted a sensitivity analysis to assess the robustness of the findings [70]. Nineteen (57.6%) reported less than 15% drop out and were classed as low risk for the purpose of meta-analysis [41,43–46,49–51,53,54,56,58,61,63–69].

### 3.3.2. Other Study Designs

#### 3.3.2.1. Study Description
All nineteen studies in this category tested indicated therapeutic interventions. The majority employed a pre-test/post-case series study design (k = 11; 57.9%) [73–83]. Sixteen (84.2%) recruited participants from community mental health services or hospitals, including inpatient and emergency department settings [73–80,83–91]. Interventions included DBT, CBT, and brief contact interventions. Sixteen (84.2%) of the studies in this category had a mean age of 18 or younger. Please see Table 2.

#### 3.3.2.2. Study Efficacy
Two of the five studies testing a CBT-based intervention reported reductions in suicide-related behaviour [73,86], and three reported reductions in suicidal ideation [73,75,76]. Five of the six studies testing DBT reported reductions in suicide-related behaviour [74,77,79,80,88], and four reported reductions in suicidal ideation [74,77,84,88]. Two of the three studies testing family-based interventions reported reductions in suicidal ideation [83,89], and one reported a reduction in suicide attempts [89]. One study reported a reduction in the proportion of young people reporting a suicide attempt following exposure to a crisis intervention program [78], and one reported reduced suicidal ideation following telephone counseling [81]. One study tested a brief contact intervention and reported no between-group differences [85]. A study of a problem solving intervention reported a reduction in the proportion of participants reporting suicide attempts in the treatment group compared to controls [87]. Finally, a study testing an intervention for American Indians reported reductions in suicidal ideation over time [82]. Significance testing was not always conducted or reported for studies in this category.

#### 3.3.2.3. Study Quality
Only seven studies had dropout rates of less than 15% [73,78,81,83,84,86,89]. All but one [89] were either underpowered or the adequacy of the sample size could not be determined. Eight studies used a comparison group [84–91]. Three assessed outcomes using interview-rated measures [87,90,91], and only one reported that outcome assessors were blinded to treatment allocation [91]. Fifteen studies (78.9%) conducted statistical testing to measure change from baseline [73–75,77,79–86,88,89,91].

### 3.4. Studies Conducted in Educational and Workplace Settings

Thirty-one studies recruited participants from educational or workplace settings; of these 21 (67.7%) were conducted in schools [92–112], seven (22.6%) in universities [113–119], two (6.5%) in military-based workplace settings [120,121], and one (3.2%) from both schools and public places in the community [122]. Twenty-one (67.7%) had a mean participant age of 18 years or younger, eight studies (25.8%) had
a mean age over 18, and in two studies (6-5%) the mean age could not be determined. Fifteen (48.4%) were RCTs.

3.4.1. Randomized Controlled Trials

3.4.1.1. Study Description. Three of the RCTs tested universal interventions [92,113,119], nine tested indicated interventions [95–98,114–116,122,123], and three tested multi-modal or multiple interventions [99–101]. Studies were either educational or therapeutic in nature, and four tested an internet-based intervention [113,119,122,123]. On large cluster-RCT tested three distinct interventions (workshops for students; gatekeeper training; and screening) [101]. Two multimodal studies combined a universal educational component with screening. Examples of control conditions in these studies included TAU e.g. an interview with a school counselor, enhanced TAU, e.g. weekly therapy, and placebo e.g. a video about unrelated health issues. Ten studies (66.7%) in this category included participants with a mean age of 18 or under. See Table 3.

3.4.1.2. Study Efficacy. Eleven RCTs reported data amenable to meta-analysis [92,98,99,101,113–116,119,122,123]. Together there were 13 individual intervention arms because one study tested three interventions (one brief contact intervention and two universal educational interventions) [101]. Two intervention arms were brief contact interventions, five were universal educational interventions, and six were psychological interventions. As above findings are presented according to the outcome assessed, with the primary outcome (self-harm) reported first, followed by suicidal ideation. No studies reported suicide as an outcome.

3.4.1.2.1. Self-harm Measured Dichotomously. Compared to control, there was evidence of an intervention effect on self-harm at post-intervention (k = 3, RR = 0.31, 95% CI 0.15 to 0.61, I² = 0%) (Fig. 4) and at follow-up (k = 3, RR = 0.63, 95% CI 0.42 to 0.96, I² = 0%) (Fig. 5).

<table>
<thead>
<tr>
<th>Study name</th>
<th>Statistics for each study</th>
<th>Risk ratio and 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asarnow, 2011</td>
<td>0.884</td>
<td>0.246</td>
</tr>
<tr>
<td>Bertolote, 2010</td>
<td>1.020</td>
<td>0.720</td>
</tr>
<tr>
<td>Carter, 2010</td>
<td>1.174</td>
<td>0.838</td>
</tr>
<tr>
<td>Doulden, 2005</td>
<td>1.714</td>
<td>0.534</td>
</tr>
<tr>
<td>Hassian-Moghaddam, 2011</td>
<td>0.634</td>
<td>0.477</td>
</tr>
<tr>
<td>Huey, 2004</td>
<td>0.739</td>
<td>0.430</td>
</tr>
<tr>
<td>King, 2006</td>
<td>1.485</td>
<td>0.833</td>
</tr>
<tr>
<td>Mehram, 2016</td>
<td>0.418</td>
<td>0.117</td>
</tr>
<tr>
<td>Robinson, 2012</td>
<td>1.558</td>
<td>0.396</td>
</tr>
<tr>
<td>Rossouw, 2012</td>
<td>0.670</td>
<td>0.483</td>
</tr>
<tr>
<td>Cooney, 2010</td>
<td>2.308</td>
<td>0.235</td>
</tr>
<tr>
<td>Asarnow, 2017</td>
<td>0.122</td>
<td>0.007</td>
</tr>
<tr>
<td>0.886</td>
<td>0.769</td>
<td>1.080</td>
</tr>
</tbody>
</table>

Fig. 2. Random effects risk ratio and 95% confidence interval (CI) for clinical interventions at the post-intervention assessment.

Fig. 3. Random effects risk ratio and 95% confidence interval (CI) for clinical interventions at the longest follow-up assessment.
3.4.1.2.3. Self-harm Measured Continuously. Compared to control, there was one study that reported continuous data post-intervention [115] with little evidence of an effect (k = 1, SMD = −0.16, 95% CI −0.61 to 0.30). No studies reported follow-up data for this outcome.

3.4.1.2.4. Suicidal Ideation Measured Dichotomously. Compared to control, there was little evidence of an effect at post-intervention (k = 1, RR = 0.76, 95% CI 0.50 to 1.16) or follow-up (k = 2 (4 intervention arms), RR = 0.72, 95% CI 0.51 to 1.03, I² = 0%).

3.4.1.2.5. Suicidal Ideation Measured Continuously. Compared to control, there was strong evidence of an effect of the intervention on suicidal ideation at post-intervention (k = 7, SMD = −0.41, 95% CI −0.57 to −0.24, I² = 15.2%). By follow-up, the effect was no longer significant (k = 5, SMD = −0.21, 95% CI −0.52 to 0.1, I² = 46.9%).

Four RCTs were not included in the meta-analysis. One tested a supportive intervention and found decreases in ‘suicide risk behaviors’ in treatment and control groups, but no between-group differences [95]. One examined a parent-specific intervention and found reductions over time in both groups, with greater reductions in the treatment group [96]. A group ‘coping with stress course’ tested with African-American adolescents was associated with a relative risk reduction in group [97]. The second examined the impact of a university suicide prevention policy and reported a reduction among the intervention group compared to increases among controls [98]. Of the remaining three studies of indicated interventions, only one therapeutic-based intervention was associated with a reduction in suicidal ideation from pre- to post-test [112].

Four studies tested a multimodal intervention. One was conducted in a workplace setting and reported lower suicide rates at post-intervention [120]. Two studies reported decreases in suicide attempts [107,109]. The final study examined the impact of a combined therapeutic and screening intervention and reported reductions in suicidal ideation at post-intervention and follow-up [108].

3.4.2. Other Study Designs

3.4.2.1. Study Description. Of these 16 studies, four were non-randomized experimental trials [93,94,103,107,117], four were pre-test/post-test case series studies [102,108,110,112], three were post-test case series studies [104–106], and four employed an interrupted time series design [109,118,120,121]. The majority were conducted in school settings (k = 12; 75.0%), with two each (12.5%) conducted in university [117,118] and military settings [120,121]. Five studies tested universal educational programs [93,94,102,103,110], two evaluated selective interventions [104,121], five evaluated indicated interventions [105,106,112,117,118] and four evaluated multimodal interventions [93,94,102,103,110,120]. Two studies evaluated online interventions [108,112]. Eleven studies (68.8%) in this category had a mean participant age of 18 or under. See Table 4.

3.4.2.2. Study Efficacy. Of the five studies testing universal interventions, one reported a reduction in suicide-related behavior post-intervention [94], one reported a reduction in suicidal ideation post-intervention and at follow-up [110], and one reported a reduction at follow-up only [102]. Two studies tested selective interventions; one showed no effect of a counseling session delivered to school students bereaved by suicide [104] and the second reported a reduction in suicide attempts associated with a training intervention delivered to U.S. naval instructors [121].

Two of the five studies testing indicated interventions assessed suicide rates as the outcome of interest. The first found no impact of a therapeutic program among secondary school students [105]. The second examined the impact of a university suicide prevention policy and reported a reduction among the intervention group compared to increases among controls [118]. Of the remaining three studies of indicated interventions, only one therapeutic-based intervention was associated with a reduction in suicidal ideation from pre- to post-test [112].

Four studies tested a multimodal intervention. One was conducted in a workplace setting and reported lower suicide rates at post-intervention [120]. Two studies reported decreases in suicide attempts [107,109]. The final study examined the impact of a combined therapeutic and screening intervention and reported reductions in suicidal ideation at post-intervention and follow-up [108].

3.4.2.3. Study Quality. Only one study [117] reported an attrition rate of less than 15%. Three studies were adequately powered [105,108,120], and in another three, although no power calculations were provided, the sample size was sufficient to examine changes in suicidal ideation but not self-harm [102,107,109]. The majority of studies (k = 12; 75.0%) used statistical testing to measure change from pre- to post-test [93,94,102,104,106,108,110,112,117,118,120,121].

3.4.3. Additional Studies

3.4.3.1. Study Description. Fourteen studies in this category (87.5%) were interrupted time series studies [124–137]; two (14.3%) utilized a control group [124,133]. One study was a non-randomized experimental trial [138] and one was an ecological study [139]. None of the community-based studies were RCTs. Eight (50.0%) evaluated means restriction approaches, five (31.3%) tested multimodal interventions [124,127,129,130,134] and two (12.5%) evaluated multiple interventions [133,139]. One non-randomized experimental trial [138] examined the impact of a cultural intervention among indigenous young people in Alaska.

3.4.3.2. Study Efficacy

Five of the six studies examining the impact of policies designed to restrict access to firearms reported decreases in the firearm suicide rate among young people [125,126,128,132,135], and one reported an

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### Table 4

<table>
<thead>
<tr>
<th>Study name</th>
<th>Statistics for each study</th>
<th>Risk ratio and 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Lower limit</td>
</tr>
<tr>
<td>Hetrick, 2017</td>
<td>0.165</td>
<td>0.009</td>
</tr>
<tr>
<td>Pistorello, 2012</td>
<td>0.147</td>
<td>0.008</td>
</tr>
</tbody>
</table>

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Fig. 4. Random effects risk ratio and 95% confidence interval (CI) for educational interventions at the post-intervention assessment.
increase [131]. Only one reported a decrease in the overall youth suicide rate [132].

Two studies examined the impact of regulatory action to restrict use of antidepressants and found no evidence of an effect on suicide rates [136,137]. One of these studies also examined the impact of such regulatory action on rates of hospital admissions for self-harm and reported decreases in females only [136].

Three of the five studies evaluating multimodal interventions reported generally positive impacts on rates of suicide and/or suicide-related behaviour [127,130,134]. One study found the suicide rate decreased by 5–3% in 15–19 year-olds but increased by 38% in 10–14 year-olds [129]. Finally, one study evaluated the impact of an intervention targeting self-immolation in women; the authors reported a reduction in the number and percentage of self-immolation cases but did not report statistical significance [124].

One study evaluated multiple interventions delivered across different counties in the U.S. The interventions were associated with lower rates of suicide attempt [139] and suicide [38] but there was no evidence of a longer-term effect. Finally, a study evaluating the impact of government-initiated national suicide prevention programs across multiple nations reported decreases in suicide rates [133].

3.5.3. Study Quality

In 11 studies (73–3%), data were collected at multiple time points [125–131,134–137] and in 11 studies the intervention was deemed unlikely to impact data collection for the primary outcome of interest [125, 126,128,130–133,135–137,139].

4. Discussion

This review examined 99 individual studies of interventions designed to reduce suicide-related behaviors among young people. Samples were diverse, although few studies were conducted in low-to-middle income countries. Studies were conducted across a range of settings and tested a variety of intervention approaches, reflecting the spread of suicide prevention activity as recommended by current policy [7,1]. Less than half the studies were RCTs, which is unsurprising as the lack of RCTs in suicide prevention has been highlighted previously [24,140]. Although not all intervention approaches, or intervention types, lend themselves to being tested this way, there remains a clear need for high-quality intervention studies in this field. In the majority of studies the mean age of participants was 18 or under (68.7%). In the clinical studies this was more prominent than in those conducted in educational settings (76.9% compared to 67.7%), suggesting that the findings from the clinical trials may be most applicable to young people aged 18 and under.

The number of intervention studies in youth suicide prevention has doubled in recent years, which is encouraging. However, many studies tested interventions originally designed for adults with little, or no, adaption for young people [24]. This may partially account for the high rates of attrition in many of the studies reviewed. Adolescence and young adulthood are developmental periods requiring specific attention [141,142]. As such interventions that account for developmental stage and are both acceptable to, and ideally co-designed with, young people are necessary.

The meta-analysis showed little evidence that interventions reduced repetition of self-harm at post-intervention in clinical settings. Whilst there was some evidence for reduced repetition of self-harm at follow-up, this effect disappeared after removing low-quality studies; as such these findings should be interpreted with caution. There may be a small effect on frequency of self-harm measured continuously. It is possible that these effects are being driven by the large trial by Hassanian-Moghaddam and colleagues that tested a brief contact intervention in Iran [68]. This finding is in contrast to a review by Ougrin and colleagues, which found evidence of benefit for clinical interventions in reducing the proportion of adolescents re-engaging in repeat self-harm [143]. This variation in findings may be explained by the settings in which the studies were conducted, or may be attributable to methodological differences such as the more specific inclusion criteria employed by the current review and/or differences in reporting of results (i.e., use of relative vs absolute effect size). There was also strong evidence of a small effect on suicidal ideation at post-intervention, and to a lesser extent at follow-up, again possibly being driven by the large Hassanian-Moghaddam trial [68].

There is less evidence for interventions delivered in educational or workplace settings given that fewer methodologically-rigorous studies have been conducted. Of note are the large studies conducted by Wasserman and colleagues [101] and Schilling and colleagues [99]. The educational components of the interventions tested in these studies appeared to reduce self-harm at post-intervention and at follow-up [99–101], although there were too few studies to conduct meaningful sub-group analyses. There was also an effect on suicidal ideation at post-intervention, but not follow-up. Overall these results indicate that school-based psycho-educational interventions that are coupled with screening have the potential to be effective, however the robustness of findings is hampered by study quality.

To some extent the overall limited effects detected may reflect a lack of statistical power, either due to small sample sizes at baseline or high attrition rates. Many studies (in particular those of indicated interventions) were underpowered and did not find statistically significant improvements despite the direction of effect being positive. This was particularly true for studies examining self-harm given the large sample sizes required to detect an effect [144]. It may also be that suicidal ideation and self-harm are different constructs, and whilst it is largely accepted that they exist along a continuum [145], specific processes may facilitate the transition from suicidal ideation to suicide attempt [146]. It may therefore be the case that existing interventions more effectively target suicidal ideation than self-harm, and that interventions with
stronger theoretical underpinnings are required to reduce self-harm and suicide. Further work delineating the modifiable risk and protective factors associated with repeated self-harm is therefore required [147]. Evidence regarding the efficacy of interventions in community settings was mixed. The studies that examined the impact of multimodal interventions generally reported reductions in rates of suicide and/or self-harm, although study quality was variable. These findings are encouraging given the emphasis in many countries on place-based responses to suicide prevention [148,149]. The interventions tested typically comprised universal educational programs, gatekeeper training, screening, and treatment responses where appropriate, and appeared to positively impact young people. These intervention types should be included in future place-based approaches and subject to rigorous testing.

Means restriction, such as reducing access to known jumping sites, has long been considered an effective suicide prevention intervention [17,18]. Our review identified few studies examining the effects of means restriction on young people, and those that did focused on firearm restriction. These were generally associated with decreases in rates of firearm suicide, but no reduction in overall youth suicides. An explanation may be that firearm suicides are relatively uncommon among youth in the countries studied. For example, three studies were conducted in Canada where the most common method of youth suicide is hanging [150]. It stands to reason that restricting access to a particular method will only reduce overall suicide rates if it is a method commonly used by the population.

Despite the spread of studies across intervention types and settings, gaps existed. For example, General Practitioners (GPs) are often a first port of call for young people yet there were no studies in primary care settings. GPs and have identified the need for training in youth suicide prevention [151]; as such primary care settings may provide an opportunity for intervention early in the suicidal trajectory that is currently being missed. Additionally, few studies were conducted in universities or workplaces compared to schools. Given that suicide rates are highest post-school age [152], tertiary education facilities and workplaces are key settings for future suicide prevention efforts and greater evidence is required [142,153]. Moreover, only six studies tested online interventions; all were in educational settings. There is increasing evidence supporting the efficacy of online interventions in the treatment of depression and anxiety [154], as well as evidence supporting their acceptability with young people at risk of suicide and potential to reduce risk [155]. All the studies of online interventions were CBT-based and most appeared to show promise, raising the question of why online interventions are not being trialed in clinical settings. This is an important avenue for youth suicide prevention yet to be capitalized on.

Finally, there are some groups who are underrepresented in this research. Only three studies [93,94,138] tested interventions among indigenous young people, despite this group being at elevated risk in many countries [156]. Similarly, same-sex-attracted and gender diverse young people are at elevated risk of suicide [157], yet only one study specifically targeted same-sex attracted youth [83]. Whilst this may be partially due to methodological challenges [156,158], generating evidence regarding effective suicide prevention approaches for these populations must be a priority. Related to this, females were over-represented in the studies reviewed. This is unsurprising given the higher rates of both self-harm and help-seeking among females compared to males [159,160], however there is a lack of knowledge regarding effective interventions for young men, whose rates of suicide are three times those of females [1].

A strength of this review is the inclusion criteria used. These were both broad (e.g., no restrictions on intervention approach or study design) and specific (i.e., studies tested interventions that were specifically designed for suicide prevention and reported suicide-related outcome data). Whilst some potentially effective interventions may have been excluded (e.g., those designed to treat or prevent depression), this review is well-placed to provide guidance regarding what does and does not impact suicide-related outcomes in young people. Despite this, some limitations must be addressed.

Firstly, the broad scope of the review, together with time and resource constraints, required us to make a number of pragmatic methodological decisions. For example, we adopted a pragmatic approach to assessing study quality, as applying standard Risk of Bias criteria to the non-RCTs would result in a low quality rating for all studies. Although we acknowledge the high risk of bias associated with non-randomized study designs, ethical and methodological barriers often prevent suicide prevention researchers from conducting RCTs. To accommodate this, the quality of non-RCTs was assessed using a tool appropriate to that design. Overall, however, study quality was limited. Indeed, many RCTs were not reported according to the Consort statement [161] and many were underpowered. Whilst this is not uncommon in suicide prevention research [144], priority needs to be given to well-designed, sufficiently powered studies. Additionally, for pragmatic reasons we did not include analysis of publication bias in our analysis of study quality. Other minor methodological limitations relate to our decisions not to prospectively register the review and not to contact key authors in the field. Although these steps are encouraged, they are not a requirement of compliance with the PRISMA statement and were not anticipated to impact the results; therefore due to time and resource constraints they were not a part of the present review.

A third limitation relates to the quality of the studies included in the meta-analysis, the results of which should be treated with caution. Additionally, on several occasions different studies contributed data to the post-intervention and follow-up outcomes. We therefore cannot be certain that changes at follow-up are in fact the result of a true reduction in the treatment effect over time. There was also heterogeneity in the control conditions and in the outcome measures used between studies, limiting our ability to be confident that studies measured the same constructs. For example, methods to assess self-harm included self-report instruments, hospital data and clinician-rated interviews. It was also often unclear if measures had been validated among young people. Researchers have previously called for the use of well-validated and standardized measures in adult suicide research, and we argue the same is required in studies with youth [162].

Finally, we acknowledge that a number of relevant studies have been published since the search was conducted. For example, a 2018 RCT trial found no benefit of systemic family therapy compared to treatment as usual in reducing subsequent hospital presentations for young people who self-harm [163]. Another RCT found DBT was more effective in reducing repeat suicide attempts in adolescents, compared to individual and group supportive therapy [164]. Although these studies both meet criteria for inclusion in the current review they were published after our search was conducted.

5. Conclusion

This review identified a large number of studies testing a broad range of interventions across multiple settings. We found that some interventions for example, brief contact interventions in clinical settings, and psychoeducation combined with screening in school settings can reduce the frequency of self-harm and suicidal ideation, although it is likely the size of these studies that is driving the effects. Large-scale multimodal interventions also show promise. Despite these promising findings there remains a paucity of high-quality youth suicide prevention intervention studies. Whilst not all interventions lend themselves to testing via RCTs, other robust study designs can and should be employed. Additionally, many studies, particularly those in clinical and community settings, tend to test interventions originally designed for adults. By focusing suicide prevention efforts on generic, as opposed to youth-specific, interventions, we are likely missing crucial opportunities for intervention, such as delivery via online platforms. Future research should adapt known effective interventions for young people,
and for delivery online. A focus on university and workplace settings is also warranted.

Although young people have repeatedly been identified by suicide prevention policy as a group requiring specific attention, their suicide rates are rising. To reverse this trend, we need more large-scale methodologically-rigorous studies that develop and test new approaches. These approaches should be acceptable to all young people and capitalize on the ways in which young people interact with the health system, supports, and services.

Supplementary data to this article can be found online at https://doi.org/10.1016/j.eclinm.2018.10.004.

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Outstanding Questions

• Despite the encouraging findings, key questions remain as to exactly which components of interventions, in particular those delivered in clinical settings, are most effective when it comes to reducing suicide risk among young people.

• There is also a pressing need for large-scale high quality trials in clinical, educational and community settings. This includes in primary care, tertiary education and online settings, which are currently largely neglected.

• Questions also remain as to what interventions are most likely to be effective in sub-sections of the population, including among indigenous young people, those who live in low to middle income countries, and those who identify as same sex attracted and/or gender diverse.

Author Contributions

Jo Robinson obtained funds for the study. She oversaw the design and conduct of the review, including data extraction, analysis and interpretation. She wrote the manuscript. She also played a leading role in the design of the search strategy.

Eleanor Bailey was responsible for conducting the literature search and coordinating the screening and data extraction phases. She also assisted with designing the search strategy, screening, data extraction, interpretation of results and preparation of the manuscript.

Katrina Witt assisted with screening and data extraction, and was responsible for conducting and interpreting the meta-analysis together with Sarah Hetrick.

Nina Stefanac assisted with screening, data extraction and preparation of the manuscript.

Allison Milner assisted with screening and data extraction.

Dianne Currier assisted with screening and data extraction. Jane Pirkis provided methodological and conceptual advice. She also contributed to writing the manuscript.

Patrick Condron assisted with the development of the search strategy.

Sarah Hetrick assisted with the development of the search, assisted with screening and data extraction, was responsible for conducting and interpreting the meta-analysis with Katrina Witt, and provided general oversight to the study.

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