

As Safe as Possible (ASAP): A Brief App-Supported Inpatient Intervention to Prevent Postdischarge Suicidal Behavior in Hospitalized, Suicidal Adolescents

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Objective: The authors report on a pilot study of an inpatient intervention for suicidal adolescents, As Safe as Possible (ASAP), supported by a smartphone app (BRITE) to reduce suicide attempts following hospital discharge.

Method: Across two sites, 66 adolescents hospitalized for suicidal ideation (N=26) or a recent suicide attempt (N=40) were randomly assigned to the ASAP intervention program plus treatment as usual or to treatment as usual alone. ASAP, which focuses on emotion regulation and safety planning, is a 3-hour intervention delivered on the inpatient unit. The BRITE app prompted participants to rate their level of emotional distress on a daily basis and provided personalized strategies for emotion regulation and safety planning. A blind, independent evaluator assessed suicide attempts following hospital discharge and suicidal ideation at 4, 12, and 24 weeks after discharge.

Results: The ASAP intervention did not have a statistically significant effect on suicide attempt, although findings were

in the hypothesized direction for occurrence of an attempt (16% compared with 31%; $\chi^2=1.86$, $df=1$, $g=-0.36$) and time to an attempt (hazard ratio=0.49, 95% CI=0.16, 1.47). Past history of a suicide attempt was a significant moderator of treatment outcome, with a stronger, albeit nonsignificant, effect of the ASAP intervention among participants with a history of suicide attempt (hazard ratio=0.23, 95% CI=0.05, 1.09). There were no treatment effects on suicidal ideation. The majority of participants (70%) used the BRITE app (median usage, 19 times). Participants reported high satisfaction with both the intervention and the app.

Conclusions: The ASAP intervention program shows promise in reducing the incidence of postdischarge suicide attempts among adolescents hospitalized for suicidality and merits further study.

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Adolescent suicide and suicidal behavior have shown dramatic increases in the past decade (1, 2). From 2007 to 2015, the adolescent suicide rate increased 30% among males and doubled among females, making suicide the second leading cause of death in this age group (1, 2). Parallel increases have been reported in emergency department visits for adolescent self-harm behavior, which showed an annual rate of increase of 5.7% from 2009 to 2015, with the greatest increases among younger adolescent females (3, 4).

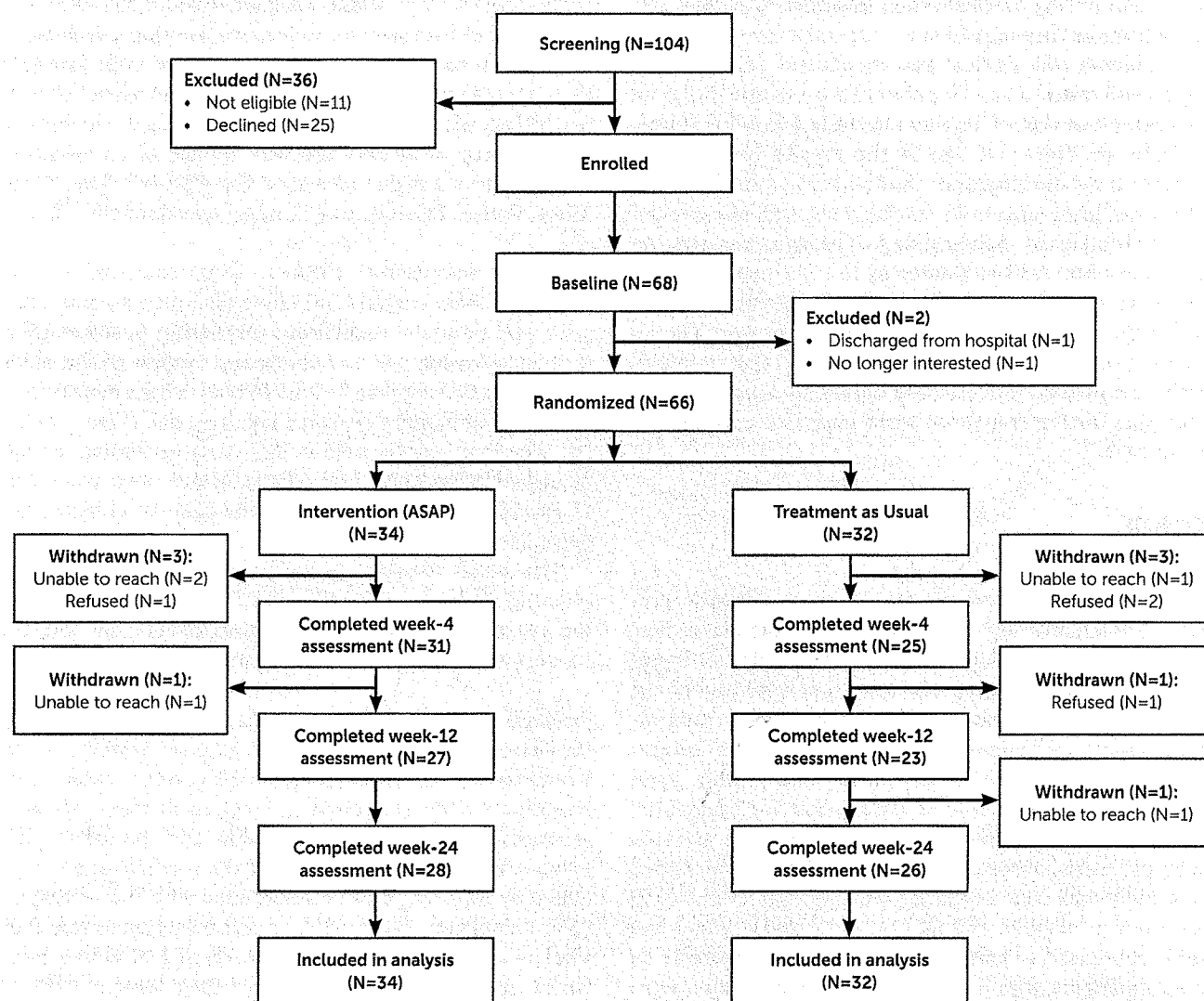
The standard of care is to hospitalize adolescents who are deemed to be at highest imminent risk for a suicide attempt (5, 6). However, the risk for suicidal behavior after discharge from the hospital is extraordinarily high (7, 8), and currently there are no interventions designed to decrease the risk of

suicide attempt during this high-risk time, which encompasses the transition from inpatient to outpatient care (9).

Researchers have developed interventions for suicidal adolescents that include distress tolerance, emotion regulation, and safety planning, with some promising results (10–15). Nevertheless, in spite of specialized interventions designed to target suicidal behavior, a large proportion of suicidal events (i.e., increase in suicidal ideation or suicide attempt) occur within the first 3 weeks of outpatient treatment following hospital discharge (16, 17), meaning that even rapid referral to outpatient care may only partially obviate the high rate of suicidal behavior after hospital discharge. Because suicidal events commonly occur early in outpatient care following hospitalization, one possible strategy

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FIGURE 1. CONSORT Diagram for a Study of the "As Safe as Possible" (ASAP) Intervention for Suicidal Adolescents



sessions were audio-recorded. Weekly supervision telephone calls were held to review cases and monitor treatment quality. The major components of the treatment (motivational interviewing, chain analysis, distress tolerance, savoring, and safety planning) were quality rated for 20% of the ASAP sessions by study coauthors with expertise in each component. The quality rating for motivational interviewing was derived from the Motivational Interviewing Treatment Integrity (version 3.1.1) (27). Quality ratings for chain analysis, distress tolerance, and savoring were derived from the Cognitive Therapy Scale (28), and the quality of the safety planning was reviewed with the Safety Plan Rating Scale (for further details, see the online supplement). Eighty percent or more of all sessions (N=29) were rated as adequate.

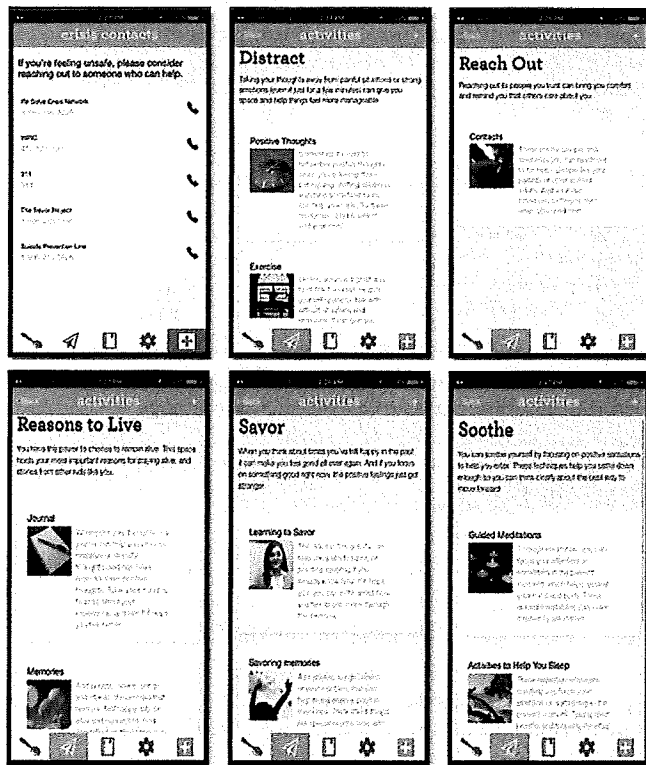
Assessments

Demographic information, intake diagnoses, and length of hospital stay were obtained from medical records.

Assessments included dimensional measures of psychopathology (with the Youth Self-Report scale) (21), anxiety (with the five-item Screen for Child Anxiety Related Emotional Disorders scale) (29), depression (with the nine-item Patient Health Questionnaire) (18), and alcohol and drug use (with CRAFFT) (22). Clinical treatment targets were reasons for living, assessed with the Reasons for Living Inventory for Adolescents (30), emotion regulation, assessed with the Regulation of Emotions Questionnaire (31), distress tolerance, assessed with the Distress Tolerance Scale (32), and social support, assessed with the Multidimensional Scale of Perceived Social Support (33).

Assessments were conducted at baseline and weeks 4, 12, and 24 by independent evaluators blind to study condition. Independent evaluators were supervised by trained and experienced evaluators. Independent ratings of audiotaped evaluations on the Columbia–Suicide Severity Rating Scale (20) showed excellent interrater reliability (kappa values ranged from 0.63 [SE=0.27] to 0.83 [SE=0.28]).

FIGURE 3. Screenshots From a Smartphone App Used in the “As Safe as Possible” Intervention for Suicidal Adolescents



RESULTS

Of the 66 randomly assigned participants, 34 were randomly assigned to ASAP intervention plus treatment as usual, and 32 were randomly assigned to treatment as usual alone. Because the timing of our assessments was from baseline rather than from hospital discharge, three participants completed the week 4 assessments while still in the hospital, and one of the week 12 assessments was conducted for a participant during a readmission hospitalization. Six participants (9.1%, three in each treatment group) did not complete any follow-up assessments. There were no site differences between the two groups in loss to follow-up (3.5% compared with 13.5%, Fisher’s exact test, $p=0.22$). Participants who were lost to follow-up, compared with participants who were retained for at least one assessment, had higher baseline suicidal ideation (mean=78.3 [SD=7.2] compared with mean=65.5 [SD=22.7], $t=3.11$, $p=0.01$) and higher levels of self-reported anxiety (mean=56.8 [SD=4.9] compared with mean=47.6 [SD=16.0], $t=3.23$, $p=0.004$).

Baseline Characteristics

Comparisons between the two groups at baseline are summarized in Table S1 in the online data supplement. The ASAP plus treatment as usual group demonstrated greater sleep disturbance on the Pittsburgh Sleep Quality Index (38) (ASAP plus treatment as usual group: mean=12.4

[SD=3.7]; treatment as usual group: mean=10.1 [SD=3.6]; $t=2.47$, $p=0.02$).

Site differences included age (mean=15.7 years [SD=1.1] compared with mean=14.6 years [SD=1.7], $t=3.04$, $p=0.004$), annual income bracket (mean=3.0 [SD=1.5] compared with mean=3.9 [SD=1.3], $z=-2.31$, $p=0.02$), living with both biological parents (N=5 [17.2%] compared with N=19 [52.8%], $\chi^2=8.71$, $df=1$, $p=0.003$), lifetime suicidal ideation with plan and intent (N=29 [100.0%] compared with N=30 [83.3%], $\chi^2=5.32$, $df=1$, $p=0.03$), and number of weeks hospitalized (mean=3.5 [SD=2.8] compared with mean=1.1 [SD=0.2], $z=6.53$, $p<0.001$).

ASAP Intervention and Bridging Calls

The median total duration of the inpatient intervention was 2.7 hours (interquartile range=2.8 hours), delivered over a median of three sessions (interquartile range=1), averaging 53 minutes per session. Two participants (5.9%) had two sessions, 18 (52.9%) had three, 12 (35.3%) had four, and two (5.9%) had five.

Of the 34 participants who received ASAP plus treatment as usual, 10 had family sessions, with a median duration of 23 minutes (interquartile range=15 minutes). After hospital discharge, 26 of the 34 participants received at least one bridging telephone call (median=1.5, interquartile range=2), with a median total duration of 17.5 minutes (interquartile range=35).

Follow-Up Assessments

Suicidal behavior. There were no significant differences in the rates of suicide attempts after hospital discharge, although the results were in the hypothesized direction (ASAP plus treatment as usual group: N=5 [16.1%]; treatment as usual group: N=9 [31%]; $\chi^2=1.86$, $df=1$, $p=0.17$, $g=-0.36$) (Table 1), as were the results for time to attempt between the two groups (Wilcoxon: $\chi^2=0.76$, $df=1$, $p=0.38$; log-rank: $\chi^2=1.74$, $df=1$, $p=0.19$; hazard ratio=0.49, 95% CI=0.16, 1.47, $z=-1.27$, $p=0.20$).

Past history of a suicide attempt moderated treatment outcome (hazard ratio=0.07, 95% CI=0.01, 0.79, $z=-2.15$, $p=0.03$), with a stronger, albeit nonsignificant, effect of ASAP plus treatment as usual among patients with a history of suicide attempt (hazard ratio=0.23, 95% CI=0.05, 1.09, $z=-1.85$, $p=0.06$).

Because our intent for the intervention was to reduce suicide attempts following hospital discharge, we reanalyzed the data excluding three participants who were still in the hospital at the time of suicide attempt. The difference in the rates of suicide attempts between the two groups was not significant but was in the hypothesized direction (10.3% [N=3] compared with 28.6% [N=8]; $\chi^2=3.04$, $df=1$, $p=0.08$, $g=-0.47$), as was the difference in time to treatment (Wilcoxon: $\chi^2=1.66$, $df=1$, $p=0.20$; log-rank: $\chi^2=3.02$, $df=1$, $p=0.08$; hazard ratio=0.33, 95% CI=0.09, 1.26, $z=-1.62$, $p=0.11$). After we adjusted for significant covariates related to time to suicide attempt (age), the ASAP plus treatment as usual group had

TABLE 2. Use of the Smartphone App by Adolescents Assigned to the "As Safe as Possible" Intervention Plus Treatment as Usual

	App Usage				
	N	%	Mean	SD	Range
Viewed (yes/no)	24	70.6			
Added content (yes/no)	18	75.0			
Removed content (yes/no)	10	41.7			
			Mean	SD	Range
Number of times content was added			14.6	10.7	2–41
Number of times content was removed			9.5	5.9	2–25
Number of times mood rating was entered			28.7	29.6	1–119
Number of times crisis contacts were viewed			0.7	1.7	0–7

group: 10.5%; treatment as usual group: 26.7%; hazard ratio=0.42, 95% CI=0.08, 2.37, $z=-0.98$, $p=0.33$), as well as among participants in outpatient programs (ASAP plus treatment as usual group: 14.3%; treatment as usual group: 38.5%; hazard ratio=0.23, 95% CI=0.03, 2.02, $z=-1.33$, $p=0.18$).

Participants who had follow-up assessments were evaluated on medication use after hospital discharge. Participants assigned to ASAP plus treatment as usual were more likely to use a pharmacological sleep aid (ASAP plus treatment as usual group: $N=19$ [63.3%]; treatment as usual group: $N=10$ [34.5%]; $\chi^2=4.91$, $df=1$, $p=0.03$), whereas participants in the treatment as usual group were more likely to receive antipsychotic medication (treatment as usual group: $N=12$ [41.4%]; ASAP plus treatment as usual group: $N=4$ [13.3%]; $\chi^2=5.87$, $df=1$, $p=0.02$). Adjusting for differences in medication use did not alter our initial findings (see Tables S2–S4 in the online supplement).

DISCUSSION

In this treatment development study, we demonstrated the acceptability and feasibility of the ASAP intervention program and the supporting BRITE app. Although this randomized controlled trial was not large enough to detect even substantial clinical effects, the rate of suicide attempt among participants assigned to ASAP plus treatment as usual was half that of participants in the treatment as usual alone group, indicating that this intervention is promising and may have utility in the reduction of postdischarge suicide attempts among hospitalized, suicidal adolescents.

To our knowledge, this is the first inpatient intervention designed to reduce suicide attempts following hospital discharge, with the exception of one study conducted nearly two decades ago in which caring letters were sent after discharge to adults at high risk for suicide who refused further outpatient care (40). ASAP is brief, focused, and supported by an app, and its strongest effects were shown in

the most vulnerable subsample here, namely, participants who had made a previous suicide attempt. Supporting the likelihood that this intervention has the potential to be widely disseminated, the ASAP program was well accepted, and a high proportion of eligible participants were recruited into the study. However, the sample size was small, with limited power, and largely female and Caucasian, which limits our ability to generalize to other populations. We did not use structured diagnostic assessments but instead relied on clinical diagnoses and a self-report diagnostic tool. Another limitation was the difficulty engaging families in the intervention during hospitalization. Finally, our design did not allow us to determine which components of the intervention or app were effective.

As hypothesized, participants assigned to ASAP plus treatment as usual tended to have a lower hazard of suicide attempts after hospital discharge, with significant moderation among persons with a history of a suicide attempt. Sensitivity analyses excluding three participants who made suicide attempts while still hospitalized continued to be in the hypothesized direction. Although a larger sample will be required in order to definitively assert that ASAP is effective, these findings are plausible because the focus of the intervention was on well-recognized intervention targets for suicidal behavior (reasons for living, emotion regulation, distress tolerance, and social support).

There were no main effects for the intervention on suicidal ideation, which is consistent with our primary focus on reducing the risk of acting on suicidal urges. Participants in the ASAP plus treatment as usual group showed a higher level of social support over time compared with participants in the treatment as usual condition. Thus, the ASAP intervention appeared to affect social support, which may be related to the lower rate of suicide attempts in this treatment group.

The majority of participants in the ASAP plus treatment as usual group used the app actively, modified content, frequently rated their level of distress, activated the personal contacts on their safety plan, and reported high satisfaction with the app. Further study is needed to determine whether the app adds to the ASAP intervention, and if so, which components are the most important in protecting youths from suicidal behavior.

Although both treatment groups showed very high rates of participation in treatment after hospital discharge, the ASAP plus treatment as usual group was statistically less likely to be involved in outpatient care and, while not statistically significant, had higher rates of involvement in higher-intensity treatments. However, the effect of ASAP plus treatment as usual compared with treatment as usual alone on subsequent suicide attempts was similar among participants who were in higher levels of care and participants who were in outpatient treatment.

The low rate of family engagement in the ASAP intervention speaks to the rapid pace of inpatient care, during which parents may not have had the time or inclination to participate in research above and beyond visitation and

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