

Evidence-Based Practice in Child and Adolescent Mental Health



ISSN: (Print) (Online) Journal homepage: <https://www.tandfonline.com/loi/uebh20>


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To cite this article: Sara J. Becker, Sarah A. Helseth, Tim Janssen, Lourah M. Kelly, Katherine Escobar & Anthony Spirito (2021) Parent Smart: Effects of a Technology-Assisted Intervention for Parents of Adolescents in Residential Substance Use Treatment on Parental Monitoring and Communication, Evidence-Based Practice in Child and Adolescent Mental Health, 6:4, 459-472, DOI: [10.1080/23794925.2021.1961644](https://doi.org/10.1080/23794925.2021.1961644)


To link to this article: <https://doi.org/10.1080/23794925.2021.1961644>

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Parent Smart: Effects of a Technology-Assisted Intervention for Parents of Adolescents in Residential Substance Use Treatment on Parental Monitoring and Communication

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ABSTRACT

Promoting parent involvement in adolescent residential substance use treatment is an evidence-based principle, yet engaging parents is challenging. Parent SMART (Substance Misuse among Adolescents in Residential Treatment) is a technology-assisted intervention that was designed to engage parents of adolescents in residential SU treatment during the post-discharge transition period. A prior pilot randomized controlled trial ($n = 61$ parent-adolescent dyads) established Parent SMART's feasibility, acceptability, and preliminary effectiveness in reducing adolescent substance use and substance-related problems across both a short- (i.e., short-term) and long- (i.e., long-term residential) term care facility. The current secondary analysis extends this prior work by examining whether Parent SMART was associated with improvements in putative mediators of change: parental monitoring and parent-adolescent communication. Multi-modal assessment consisting of participant-report questionnaires and a behavioral interaction task evaluated parenting processes over the 24 weeks following discharge. Generalized linear mixed models showed no significant time by condition interactions on the participant-report questionnaires, but found significant interactions on all five scales of the behavioral interaction task. Supplemental analyses by long-term residential facility detected additional interaction effects favoring Parent SMART on the participant-report questionnaires. Plotting of the interaction effects indicated that Parent SMART was associated with improvements in parenting processes, whereas TAU was associated with relatively stable or worsening parenting scores. Parent SMART demonstrated preliminary effectiveness in improving key parenting processes among adolescents discharged from long-term residential substance use treatment. Parent SMART warrants further testing in a fully powered trial that evaluates parental monitoring and parent-adolescent communication as mediators of change.

Promoting parent involvement in adolescent long-term residential behavioral treatment is a best practice and evidence-based principle (Christenson & Merritts, 2017; Nickerson et al., 2006; Robst et al., 2013). In 2009, the Residential Care Consortium released a white paper outlining a set of broad recommendations to improve parent engagement in adolescent long-term residential treatment (Affronti & Levison-Johnson, 2009). The six recommendations included: (1) involving parents in youth treatment by training parents in effective intervention strategies; (2) focusing on transitions in care when disruptions in treatment continuity are most common; (3) using assessments that measure family processes to evaluate effectiveness; (4)

implementing strategies that reduce barriers to engagement; (5) offering parents educational opportunities to address the needs of the specific population; and (6) using parent mentors who have faced similar challenges to enhance networking and support. A decade later, these six principles remain key areas in need of dedicated attention (Hogue et al., 2021).

Parent involvement in youth long-term residential treatment is especially encouraged in settings treating adolescents with substance use (SU) disorders or substance-related problems (Clarahan & Christensen, 2017). Multiple systematic (Becker & Curry, 2008; Kuntsche & Kuntsche, 2016; Steele et al., 2020) and meta-analytic (Tanner-Smith

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et al., 2013) reviews have concluded that adolescent SU interventions that engage parents significantly outperform interventions involving only adolescents across the care continuum. For instance, an early review by Kumpfer et al. (2003) found that family-based interventions for adolescents with SU disorders produced effect sizes 2–9 times larger than adolescent-only models. More recent systematic reviews by Hogue et al. (2014), (2018) found that interventions involving parents and families were supported by the highest quality evidence and merited a designation as Well-Established. Further support was found in the most comprehensive meta-analysis to date by Tanner-Smith and colleagues (Tanner-Smith et al., 2013), which synthesized 73 unique comparisons of various adolescent SU interventions: this synthesis concluded that family-based interventions involving parents demonstrated the largest effects.

Two key parenting processes targeted by extant adolescent SU interventions include parental monitoring and parent-adolescent communication. Longitudinal research has consistently shown that low parental monitoring is related to both initiation of adolescent SU and early-onset use (Andrews et al., 1993; Rusby et al., 2018; Ryan et al., 2015). Several studies have implicated parental monitoring as a mechanism underlying adolescent SU, with one study of 4,731 adolescents finding that perceived parental monitoring had unique mediating effects on adolescent SU (Latendresse et al., 2008). Other studies have indicated that lax parental monitoring is one of the pathways through which parental SU influences adolescent use, and that more skillful parental monitoring is associated with more favorable treatment outcomes (Becker et al., 2012; Kelly et al., 2017; Chun et al., 2008). Research has also implicated effective parent-adolescent communication as a key protective factor for adolescent SU (Ackard et al., 2006; Choi et al., 2017; DeVore & Ginsburg, 2005). Communication of strong parental norms against SU has been associated with reduced risk of SU initiation (Ackard et al., 2006; Choi et al., 2017) and lower rates of SU in late adolescence (Cohen et al., 1994). In addition, interventions specifically targeting parental communication have been associated with superior treatment outcomes relative to parent interventions focusing on psychoeducation (Becker et al., 2020).

Building upon the extant research highlighting the protective roles of parental monitoring and parent-adolescent communication, we developed a technology-assisted parenting intervention, called Parent SMART (Substance Misuse among Adolescents in Residential Treatment), as an adjunct to long-term residential treatment for adolescents with substance-related problems. The Parent SMART intervention consisted of three elements – a computer program, a smartphone app, and coaching sessions – each of which were developed in response to formative research with parents of adolescents in long-term residential treatment (Becker et al., 2017). Combined, the elements of Parent SMART specifically follow the six recommendations of the Residential Care Consortium, as outlined in Table 1 (Affronti & Levison-Johnson, 2009). The long-term vision of the Parent SMART intervention is that it will help to improve the outcomes of adolescents in long-term residential treatment, by promoting parent engagement both during long-term residential treatment and during the early transition period following discharge.

To evaluate the Parent SMART intervention, we previously conducted a pilot randomized trial with 61 adolescent-parent dyads (Becker et al., 2021) recruited across one short-term (i.e., acute stay) and one long-term (i.e., residential) care facility. Results of the primary outcome analysis established the feasibility and acceptability of the Parent SMART intervention as an adjunct to long-term residential treatment as usual (TAU) among parents in both settings. Findings also supported the preliminary effectiveness of the Parent SMART intervention on reducing adolescent substance use and substance-related problems, but only among parent-adolescent dyads in the short-term facility. Results of these primary outcome analyses were a solid first step and indicated that further evaluation of the Parent SMART intervention was warranted.

The current secondary analysis aims to build upon this prior work by examining the extent to which the Parent SMART intervention was associated with change in the putative intervention mechanisms specified in the initial protocol (Becker et al., 2017): parental monitoring and parent-adolescent communication. We hypothesized

Table 1. Overview of the recommendations of the long-term residential care consortium (RCC) and how parent SMART design decisions address each recommendation.

Recommendations of RCC to involve parents in long-term residential treatment	Description of the recommendation	Parent SMART design decisions addressing each recommendation
(1) Involve parents or guardians in the active delivery of care for their children	“Train parents in effective intervention practices . . . and support parents in reinforcing these behaviors at home”	<ul style="list-style-type: none"> • Trains parents in monitoring and communication skills • Reinforces use of parental monitoring and parent-adolescent communication skills at home following long-term residential treatment
(1) Focus attention on transition services, as a mechanism to move toward implementation of family-driven strategies.	“Focused attention on transition . . . practices that promote continuity in transitions from care”	<ul style="list-style-type: none"> • Targets the vulnerable transition from long-term residential to community care
(1) Utilize assessments that adequately identify factors that may alter the strategies’ or interventions’ effect on outcomes	“Standardized assessments that can identify important variables, such as the influence of caretaker supports or caretaker demographic characteristics, can assist agencies.”	<ul style="list-style-type: none"> • Measures two putative parenting variables – parental monitoring and parent-adolescent communication • Uses multi-modal assessment to measure parenting processes through participant-report and behavioral observation
(1) Implement evidence-based strategies that reduce initial barriers to engagement.	“Engagement strategies have been incorporated as a component of evidence-based programs and are the first step in care delivery”	<ul style="list-style-type: none"> • Leverages technology to deliver key intervention components in order to reduce barriers to accessing treatment
(1) Offer family therapy and parenting education to the extent possible	“Residential treatment centers will need to select . . . parenting skills educational opportunities based on the needs of their specific population.”	<ul style="list-style-type: none"> • Provides parenting skills educational opportunities targeting processes identified as protective against adolescent substance use initiation and relapse
(1) Integrate parent mentors into practice settings who have previously had a child in long-term residential care.	“The use of parent mentors who have experienced similar challenges has been linked to a number of positive parent outcomes and a few child outcomes.”	<ul style="list-style-type: none"> • Connects parents with other parents of adolescents in long-term residential treatment (and with an adolescent SU expert) via a networking smartphone app

that parents who received the Parent SMART intervention would demonstrate greater improvements in parental monitoring and parent-adolescent communication over time, relative to those who received long-term residential TAU. Because it is inappropriate to make definitive conclusions about effectiveness from small pilot trials (Kraemer et al., 2006), these hypotheses were tested in order to identify patterns worthy of exploration in a fully powered trial of parent-adolescent dyads in long-term residential treatment. To enhance rigor, parental monitoring and communication were assessed via multi-modal assessments including participant report (both parent and adolescent-report) and behavioral observation.

Method

Procedures

Recruitment of parent-adolescent dyads was conducted at two residential SU treatment facilities for adolescents, as described previously (for a detailed description and CONSORT flow diagram see Becker et al., 2021). The short-term residential facility, which offered short-term care, was located in an urban area of New England. The long-term

residential facility, which offered standard long-term residential care, was located in a rural area in a Midwestern state. Reflecting proximity to the research team, parents at the short-term facility could choose to complete the study by phone, Zoom, or in-person, whereas those at the long-term residential facility could choose between phone or Zoom. Standard services at both facilities are described below in the *Intervention* section.

At both facilities, parent-adolescent dyads were approached for enrollment during the adolescent’s admission. Parents were invited to sign a consent to contact form allowing research staff to contact them with more information about the study and to complete a brief eligibility screener. In accordance with Institutional Review Board approved procedures (protocol ID blinded), interested parents who qualified for the study provided written informed consent using either paper or electronic consent forms. Once written/electronic parental consent was obtained, adolescents were approached separately to assess interest in participating and to complete a brief screener. Parents and adolescents had to independently provide consent and assent for an adolescent-parent dyad to enroll in the study.

Baseline assessments were scheduled shortly after admission, and coordinated with residential

facility staff. Upon completing the baseline assessment, dyads were randomized to conditions (Parent SMART + TAU vs. TAU only) by a research coordinator using an urn randomization spreadsheet that balanced on adolescents' biological sex, race/ethnicity (Non-Hispanic White vs. identification as a member of racial/ethnic minority group), and days of SU over the past 90 days (1–45 days vs. 46–90 days). Condition assignments were revealed to parents by phone or via sealed envelopes presented in person. Parents randomized to Parent SMART were scheduled for their first coaching session as soon as possible following randomization. Three additional coaching sessions were offered for up to 6 weeks following the adolescent's discharge, to bridge the transition period. Follow-up assessments were scheduled at 6-, 12-, and 24-weeks post-discharge from residential. Adolescents and parents could each earn up to 200 USD on a rechargeable gift card for completing all four study assessments.

Parent-adolescent dyads

To qualify for the study, adolescents had to be between 13 and 17 years of age, had to be admitted to residential treatment due to problems related to SU, and had to report SU within the past 90 days. Parents qualified if they were the legal guardian of an adolescent meeting the aforementioned criteria, would remain the custodial guardian post-discharge, and had reliable access to an internet-accessible device to access the Parent SMART intervention. Additionally, eligible dyads had to be fluent in English or Spanish and be able to complete a baseline assessment prior to the adolescent's discharge from residential.

Enrollment rates varied by facility. At the short-term facility, 158 parent-adolescent dyads were screened, of which 82 were eligible (52% of screened) and 37 ultimately enrolled (23% of screened, 45% of eligible). The two most common reasons for ineligibility were that the adolescent denied a recent history of SU ($n = 66$) and the adolescent was not returning home after discharge ($n = 8$). The most common reasons that eligible dyads did not enroll were that the parent could not be contacted ($n = 21$) or the parent was unable or unwilling to complete the baseline assessment prior

to discharge ($n = 15$). At the long-term facility, 51 parent-adolescent dyads were screened, of which only three were excluded due to adolescent age. Of the 48 eligible dyads (94% of screened), 26 ultimately enrolled (51% of screened, 54% of eligible). Similar to the short-term facility, the primary reasons for not enrolling were that the parent could not be contacted ($n = 13$) or was unable or unwilling to complete the baseline assessment prior to discharge ($n = 9$).

In total, 61 parent-adolescent dyads were randomized to Parent SMART ($n = 30$) or residential TAU ($n = 31$) across the two programs. Sample characteristics have been described previously (Becker et al., 2021). Briefly, most parents were biological mothers (77%) with 12% biological fathers and 5% other blood relatives. Parents were predominantly Non-Hispanic White (67%). The median household income was 54,500 USD and 61% of parents were employed full time, both of which were lower than the national average at the time of enrollment (2017–2019; Rothbaum & Edwards, 2019). Adolescents were about 16 years old on average ($M = 15.7$, $SD = 1.02$) and were more diverse than parents in terms of gender identity (42% self-identified as male and 7% as non-binary) and race (57% self-identified as White, 12% Black/African-American, 25% multi-racial, 2% Asian/Asian-American; and 5% did not identify with any previous category or preferred not to answer). Roughly 25% of adolescents identified as Hispanic/Latinx.

Based on responses to the Global Appraisal of Individual Needs-Q3 (Titus et al., 2013), a well-validated assessment used to document adolescent SU and mental health concerns, on average adolescents used substances on 59% ($SD = 39\%$) of the 90 days they were in the community prior to admission. Adolescents also reported high rates of depression and conduct symptoms: 77.0% ($n = 47$) and 56% ($n = 34$) of the sample reported three or more symptoms of depression or conduct disorder, respectively.

No differences were found between sites on any of the parent characteristics. Three between-site differences were detected on adolescent variables: relative to adolescents at the short-term facility, those at the long-term facility were older (16.3 vs. 15.3 years, $t = 4.94$, $p < .001$), less likely to identify

as female (33% vs. 60%, $\chi^2 = 3.98$, $p < .05$), and reported a greater proportion of days of SU at baseline (73% vs. 50%, $t = 2.53$, $p < .05$). Notably, there were no differences across facilities in adolescents' symptoms of depression or conduct disorder, suggesting comparable levels of mental health acuity.

Interventions

Treatment-as-usual (TAU)

TAU was the standard of care at the two facilities and was received by all 61 dyads. The "dose" of the TAU condition varied substantially across conditions. The short-term facility had an average length of stay of 6–10 days, whereas the long-term residential facility had an average length of stay of 30–45 days. The facilities also varied in terms of number of adolescents served with the short-term facility accommodating up to 16 adolescents for an short-term and the long-term facility accommodating up to 80 adolescents for standard residential care. Despite these structural differences, both facilities adhered to a dialectical behavior therapy approach and provided about 20–30 hours of treatment per week including a mix of individual, family, and group sessions, as well as medication management. Following randomization, parents at both facilities received a Parent Resource Packet created specifically for this study that contained information about adolescent substance use and local outpatient treatment options.

Parent SMART intervention

The Parent SMART intervention was initiated during the adolescent's residential stay and continued during the post-discharge period. The intervention contained three key elements, each of which was selected in response to formative feedback and available in English and Spanish: an online parenting skills program called Parenting Wisely (Ser Padres Con Sabiduría); a parent networking forum; and parent coaching sessions. Parental monitoring and parent-adolescent communication skills were emphasized across all three elements, as elaborated below.

Online program. Parents received a 24-week subscription to Parenting Wisely (PW) shortly after

admission to the facility. PW is an off-the-shelf, self-administered, multimedia online parenting intervention (see <http://www.parentingwisely.com>) that has demonstrated effectiveness in multiple trials (Cefai et al., 2010; Cotter et al., 2013; Kacir & Gordon, 2000; Stalker et al., 2018). The PW program contains video vignettes of common family problems (e.g., finding drugs, sibling conflict, monitoring schoolwork) that function akin to a "choose your own parenting adventure." After viewing a short clip of the common family problem, parents select one of three possible solutions and view a video enactment of the selected solution detailing pros and cons of the approach. Vignettes emphasize parental monitoring and parent-adolescent communication skills. Parental monitoring skills are presented through a technique called contracting (e.g., how to establish a behavioral contract). Parent-adolescent communication skills are presented through techniques including active listening (e.g., how to listen and validate the teen) and I-statements (e.g., how to share your feelings non-judgmentally).

Parents were oriented to the PW program during their first coaching session and encouraged to complete modules at home. The target dosage specified *a priori* in the study protocol (Authors et al., 2017) was two modules. Of the 30 parents randomized to Parent SMART, 83% completed at least two PW modules and 33% completed at least five ($M = 3.8$ modules, $SD = 2.3$; range 1 to 9 completed modules), with no differences across facilities.

Parent networking forum. The second Parent SMART component was a parent networking forum that was designed to foster a supportive peer community and serve as a clinical extender. Similar to PW, parents were oriented to the forum during their first coaching session and given access for 24 weeks. The forum was available via web browser or smartphone app and contained two expert-moderated message boards: Ask an Expert, where parents could ask questions of an adolescent clinical psychologist, and Connect with Parents, where parents could interact with other parents of adolescents in residential treatment. To promote engagement, parents received push notifications anytime another parent posted and also received a daily push notification containing a "Tip of Day!"

The daily tips could be subscribed to separately as SMS messages. Daily tips contained reminders to use the PW online program, links to vignettes from the PW program demonstrating parental monitoring and communication skills, and/or messages of encouragement. A google translator plugin allowed real-time translation of parent-generated content into English or Spanish.

Of the 30 parents randomized to Parent SMART, 100% reported reading app content and 21 (70%) posted in networking forum. The average number of posts per parent who engaged was 2.2 ($SD = 3.5$, range 1–18) and did not differ across facilities. There were a total of 65 posts, 15 in Ask an Expert (posted by 12 unique parents) and 50 in Connect with Parents (posted by 18 unique parents). Qualitative analysis of parent-generated content (Helseth et al., 2021) revealed that the most common topic of posts was parenting skills, with 14 posts related to parental monitoring and 12 posts discussing parent-adolescent communication.

Coaching sessions. The final intervention element was up to four parent coaching sessions, delivered by BA- or MA-level coaches. These sessions were initiated shortly after admission at each facility and had to be completed by the 6-week follow-up assessment. Sessions were designed to customize the PW and networking forum content to address each parent's unique presenting concerns, while reinforcing the focal parental monitoring and communication skills. The initial session was 60–75 minutes; coaches reviewed the rationale for Parent SMART, provided personalized feedback on current parental monitoring and parent-adolescent communication skills observed during a behavioral interaction task (described further in *Measures*), and oriented the parent to both the PW program and the networking forum. The coach and parent then watched the PW “Finding Drugs” module together, before selecting a specific parenting skill to learn and practice. Skills practiced mapped directly onto the skills covered in the PW workbook, with one exception: monitoring skills were expanded on via inclusion of the 5 W's (who, what, where, why, and when) as a skill for soliciting information about the adolescent's activities. For homework, the coach would recommend specific online modules and encourage the parent to post

any questions that arose between sessions in the networking forum. Sessions 2–4 lasted 45–60 minutes and followed a similar format, devoting less time to providing a rationale and more time to discussions around efforts to enact monitoring and communication skills in their daily lives.

Of the 30 parents randomized to Parent SMART, 29 initiated coaching sessions. On average, parents attended 2.7 coaching sessions ($SD = 1.1$; Range 1–4), with no difference across facilities. A total of 78 sessions occurred: all were rated for the coach's adherence to protocol and competence by a single coder, and 33% were double coded. The adherence target was 80% of the elements specified in the session manual, whereas the competence target was an average score of 4.0 on the Cognitive Therapy Rating Scale (Dobson et al., 1985; Young & Beck, 1980), a 6-item scale that measures general therapy skills. In total, 87% and 100% of sessions met the adherence and competence benchmarks, respectively (see Becker et al., 2021). Agreement between coders was excellent: inter-rater reliability measured via the ICC was 0.92 for adherence and 0.86 for competence.

Assessments

Parent-adolescent dyads completed a baseline assessment and three follow-up assessments at 6-, 12-, and 24-weeks after discharge from the residential facility. Retention rates at the follow-up assessments were 90%, 90%, and 85%, respectively.

Parental monitoring

Parent- and adolescent-reported parental monitoring were assessed using the Parent Monitoring Questionnaire (PMQ; Stattin & Kerr, 2000), a 24-item measure that assesses three dimensions of monitoring: adolescent disclosure, parental solicitation, and parental control. Prior research suggests that adolescent report of parent behavior is more predictive of adolescent risk behavior than parent self-reported behavior (Rusby et al., 2018). As such, adolescent report was used to capture parental solicitation and control (parent behaviors), whereas parent report was used to measure adolescent disclosure (adolescent behavior). Higher scores indicated higher levels of monitoring (Stattin & Kerr, 2000). Internal consistency of

the three subscales in the current sample was good ($\alpha = .76-.87$).

Parent-adolescent communication

Adolescent-reported parent-adolescent communication was assessed using the Parent-Adolescent Communication Scale (PACS; Barnes & Olson, 1985), a 20-item scale that measures general parent-adolescent communication (10 items) and problems with communication (10 items). Higher scores indicated more positive communication and fewer problems with communication. The two subscales have been shown to correlate with teen engagement in risk behavior (Barnes & Olson, 1985). The two subscales had good internal consistency in the current sample ($\alpha = .77-.92$).

Behavioral interaction task

In vivo assessment of parent-adolescent interactions was obtained via the Family Assessment Task (FAsTask), an audio-recorded behavioral interaction activity (Robin & Foster, 1989) adapted by Dishion and Kavanagh (2003). Dyads were given a set of instructions and asked to discuss three distinct topics for five minutes each: limit setting (parent leads discussion about a time they had to set a limit); SU norms (parent leads discussion on their views and rules about SU); and monitoring and listening (adolescent leads a discussion about a time they were with peers without supervision). A coder, blind to treatment condition, rated each 5-minute interaction on a set of 9-point Likert scales: ratings of 1–3 indicated poor parenting skills, ratings >3 to <6 indicated average parenting skills, and ratings of 6+ indicated strong parenting skills. Individual ratings yielded five distinct scale scores: limit setting (10 items), parent substance use beliefs (4 items), parent substance use communication (6 items), adolescent disclosure (7 items), and parental monitoring (9 items). Pooling across participants and timepoints, 20% of FAsTask recordings were double-coded and excellent inter-rater reliability (94% agreement) was obtained.

Analysis plan

Prior to the main analyses, bivariate correlations were examined among the parenting variables to ensure they measured independent constructs.

Additional analyses tested for both between-condition and between-site differences on the focal parenting variables using t tests.

Hypothesis testing was conducted using the same approach as the primary outcome analysis, which first conducted analyses pooled across facilities and then conducted analyses by site. Generalized linear mixed models (GLMM) controlling for site used a multilevel structural equation modeling framework, accounting for within-subject and between-subject variance on outcomes using a latent variable decomposition framework (Asparouhov & Muthén, 2019). The model included a random intercept, and a random slope representing the effect of time (coded 0, 1, 2, and 4 for baseline, week 6, week 12, and week 24 assessments, respectively). This random slope was regressed on condition, which is analogous to investigating a time*condition effect in a traditional GLMM. Both the random intercept and random slope effects controlled for the effect of site (residential facility). The baseline values of outcomes are part of the model, and baseline condition differences are included in the model as a between-subjects covariate predicting the random intercept and random slope.

The focal variable of interest was the time*condition interaction. The condition term was coded as 0 = TAU only and 1 = Parent SMART + TAU. All parenting variables were scored such that higher scores indicated higher levels of parental monitoring or parent-adolescent communication. As such, positive time*condition interactions indicated greater improvement in parenting among those randomized to Parent SMART than those randomized to TAU.

Parental monitoring and parent-adolescent communication variables were modeled with a linear (Gaussian) distribution. All models were estimated in Mplus 8.4 (Muthén & Muthén, 2017) using the maximum likelihood estimator with robust standard errors (MLR). Use of multilevel structural equation modeling with the MLR estimator assumes outcomes are missing at random, while handling missing data on endogenous variables based on relations to model predictors (Enders & Bandalos, 2001). Analyses of missing data indicated that missingness was not structurally related to any of the variables and supported these assumptions.

Due to the fundamental difference in the dosage of TAU at the residential facilities, a second set of analyses was conducted separately within each site.

The supplemental analyses, though arguably more conservative, were driven by an underlying assumption that the intervention might not have the same average effect relative to two different doses of TAU.

Results

Table 2 presents the means of focal parenting outcomes by condition and by site. Bivariate associations among parenting variables were generally between .4-.5 with none exceeding .7, suggesting that variables measured independent constructs. There were no significant baseline differences by condition on any of the parenting variables when pooling across the two residential facilities. Among those parent-adolescent dyads at the short-term residential facility, there were two within site differences: dyads randomized to TAU had higher levels of adolescent disclosure and parental monitoring, as observed via the behavioral interaction task, than dyads randomized to Parent SMART.

Adolescent-report and parent self-report measures

Table 3 depicts results from the GLMM analyses of the parent and adolescent-reported monitoring and communication questionnaires. Results from GLMM analyses identified no significant time-by-

condition interactions when pooling results across residential facilities.

Behavioral interaction task

Table 4 presents results from GLMM analyses of the scale scores of the behavioral interaction task pooled across facilities. Results from these analyses revealed significant time-by-condition interactions on all five scales. Relative to dyads randomized to TAU, those in the Parent SMART condition showed improvements in behavioral ratings of limit setting, parent beliefs about SU, parent communication about SU, adolescent disclosure, and parental monitoring over time.

Figure 1 presents these interactions graphically. The general pattern indicated consistent improvement in parenting scores among those randomized to Parent SMART, relative to those randomized to TAU. Estimates of the average effect size difference revealed that parents randomized to Parent SMART had scores on the behavioral intervention task of .X to 1.X higher than parents randomized to TAU: these scores reflect a 10–20% improvement in parenting ratings. On average, at week 24, parents randomized to Parent SMART were in the “strong parenting skills” range, whereas parents randomized to TAU were in the “moderate parenting skills” range.

Table 2. Comparisons of parenting variables at baseline by treatment condition and residential treatment setting.

Parenting variables	Short-term/acute stay residential (n = 37)			Long-term/standard residential (n = 24)			Between residential programs t-test
	TAU (n= 19) M (SD)	Parent SMART (n= 18) M (SD)	Within short-term residential t-test	TAU (n= 12) M (SD)	Parent SMART (n= 12) M (SD)	Within long-term residential t-test	
Parent-Report Questionnaires (1–5 Scale)							
Adolescent disclosure ¹	2.91 (.88)	2.86 (.94)	.17	2.98 (.76)	2.67 (1.09)	1.35	.86
Parental solicitation ²	2.55 (.89)	2.67 (1.09)	–.38	2.93 (1.07)	2.95 (1.05)	–.03	–.39
Parental control ²	3.69(1.11)	3.97 (1.20)	–.72	3.38 (1.13)	3.97 (.96)	–1.31	–1.33
General communication	30.16 (10.10)	29.17 (7.63)	.34	36.80 (9.69)	30.00 (11.11)	1.42	1.17
Problem communication	25.82 (6.77)	27.06 (5.91)	–.58	33.50 (6.60)	28.22 (11.56)	1.24	.50
Behavioral Interaction Task (1–9 Scale)							
Limit setting	5.52 (1.88)	5.22 (1.27)	.58	6.25 (1.16)	5.96 (1.86)	.44	.67
Parent SU beliefs	4.74 (2.13)	4.54 (1.86)	.29	6.73 (1.68)	5.85 (2.47)	.98 ^a	.75
Parent SU communication	4.60 (1.33)	5.14 (1.15)	–1.28	6.15 (1.50)	6.11 (1.07)	.07	–.93
Adolescent disclosure	4.91 (2.13)	4.66 (1.38)	.44*	4.98 (.75)	4.25 (1.20)	1.75	1.13
Parental monitoring	3.39 (1.93)	3.17 (1.30)	.41*	5.18 (1.50)	3.94 (1.82)	1.75	1.23

Higher scores on all scales indicate higher levels of parental monitoring and communication. Independent samples t-tests compared means of TAU and Parent SMART within the short-term and long-term residential facilities (degrees of freedom [df] = 35 and 22 for short- and long-term facilities, respectively) and between the short- and long-term facilities (df = 59). SU = substance use. ¹Parent-report. ² Adolescent-report. * $p < .05$

Table 3. Mixed model estimates of pooled treatment effects of parent SMART relative to residential treatment as usual on parenting variables assessed via questionnaires.

Parent- and adolescent-report questionnaires				
(n = 61 parent-adolescent dyads)				
		b	95% CI	p
Adolescent disclosure ¹	Time	0.04	-0.06, 0.14	.42
	Condition	-0.28	-0.68, 0.12	.17
	Time*Condition	0.10	-0.05, 0.24	.20
	Intercept	2.95	2.64, 3.25	<.001
Parental solicitation ²	Time	0.10	0.02, 0.17	.01
	Condition	-0.04	-0.48, 0.39	.85
	Time*Condition	-0.10	-0.21, 0.00	.06 [†]
	Intercept	2.81	2.55, 3.08	<.001
Parental control ²	Time	0.04	-0.05, 0.13	.37
	Condition	0.28	-0.24, 0.80	.29
	Time*Condition	-0.09	-0.19, 0.02	.12
	Intercept	3.72	3.38, 4.05	<.001
General communication ²	Time	-0.04	-0.12, 0.05	.40
	Condition	-0.42	-0.85, 0.01	.05
	Time*Condition	0.08	-0.03, 0.19	.17
	Intercept	3.35	3.05, 3.66	<.001
Problem communication ²	Time	-0.06	-0.11, -0.01	.01
	Condition	-0.13	-0.47, 0.21	.46
	Time*Condition	0.07	-0.01, 0.14	.08 [†]
	Intercept	2.86	2.63, 3.09	<.001

¹Parent-reported questionnaire, ² Adolescent-reported questionnaire. Condition was coded 0 = treatment as usual, 1 = Parent SMART. A positive time*condition interaction indicates an effect favoring Parent SMART over time. [†] $p < .10$

Table 4. Mixed model estimates of pooled treatment effects of parent SMART relative to residential treatment as usual on parenting variables assessed via behavioral interaction task.

Behavioral interaction task (n = 61 parent-adolescent dyads)				
b 95%CI				
		b	95% CI	p
Limit setting	Time	-0.17	-0.36, 0.03	.09
	Condition	-0.27	-1.01, 0.47	.47
	Time*Condition	0.37	0.06, 0.68	.02*
	Intercept	5.79	5.30, 6.28	<.001
Parent SU beliefs	Time	-0.13	-0.37, 0.12	.33
	Condition	-0.78	-1.69, 0.13	.09
	Time*Condition	0.42	0.06, 0.79	.02*
	Intercept	5.91	5.26, 6.56	<.001
Parent SU communication	Time	-0.11	-0.28, 0.06	.21
	Condition	0.18	-0.39, 0.74	.54
	Time*Condition	0.32	0.07, 0.56	.01*
	Intercept	5.40	4.99, 5.81	<.001
Adolescent disclosure	Time	0.04	-0.17, 0.25	.69
	Condition	-0.52	-1.19, 0.14	.12
	Time*Condition	0.36	0.03, 0.68	.03*
	Intercept	5.07	4.58, 5.56	<.001
Parental monitoring	Time	-0.09	-0.28, 0.10	.35
	Condition	-0.51	-1.25, 0.23	.18
	Time*Condition	0.53	0.20, 0.86	.002**
	Intercept	4.03	3.53, 4.53	<.001

SU = substance use. Condition was coded 0 = treatment as usual, 1 = Parent SMART. A positive time*condition interaction indicates an effect favoring Parent SMART over time. * $p < .05$, ** $p < .01$.

Supplemental analyses: exploring parenting processes by residential facility

Supplemental Table 1 presents the results of the GLMM analyses by residential facility. The same pattern was observed as in the pooled analyses, though some additional associations were detected.

For the adolescent- and parent-reported questionnaires, two significant associations were found among dyads in the short-term setting. Dyads who received Parent SMART at the short-term facility had greater improvements in both parent-reported adolescent disclosure and adolescent-reported problematic family communication relative to parents who received TAU only. Estimates of the average effect size difference revealed that parents randomized to Parent SMART had scores (5-point Likert scales) of .43 to .79 higher than parents randomized to TAU: these scores reflect a 9-16% improvement in parenting ratings.

For the behavioral interaction task, four significant time*condition associations were detected among dyads at the long-term residential facility. Dyads who received Parent SMART at the long-term residential facility had greater improvements observed in limit setting, parent SU beliefs, adolescent disclosure, and parental monitoring. Estimates of the average effect size difference revealed that parents randomized to Parent SMART had scores on the behavioral interaction task of 1.49 to 1.84 higher than parents randomized to TAU: these scores reflect a 17-20% improvement in parenting ratings. On average, at week 24, parents randomized to Parent SMART were in the "strong parenting skills" range, whereas parents randomized to TAU were in the "moderate parenting skills" range. Of note, all 10 of the time*condition interaction terms, across both the short-term and residential facility, had positive coefficients: these data indicated a highly consistent pattern of improvement in parenting processes over time.

Discussion

The current study examined the extent to which Parent SMART, a novel technology-assisted intervention for parents of adolescents in residential SU treatment, was associated with improvements in two key parenting mechanisms. Parent SMART was designed in-line with the Residential Care Consortium recommendations (Affronti & Levison-Johnson, 2009) to engage parents in their adolescent's residential care. The general pattern of results pooled across residential settings indicated that parent-adolescent dyads who received Parent SMART demonstrated superior improvements on

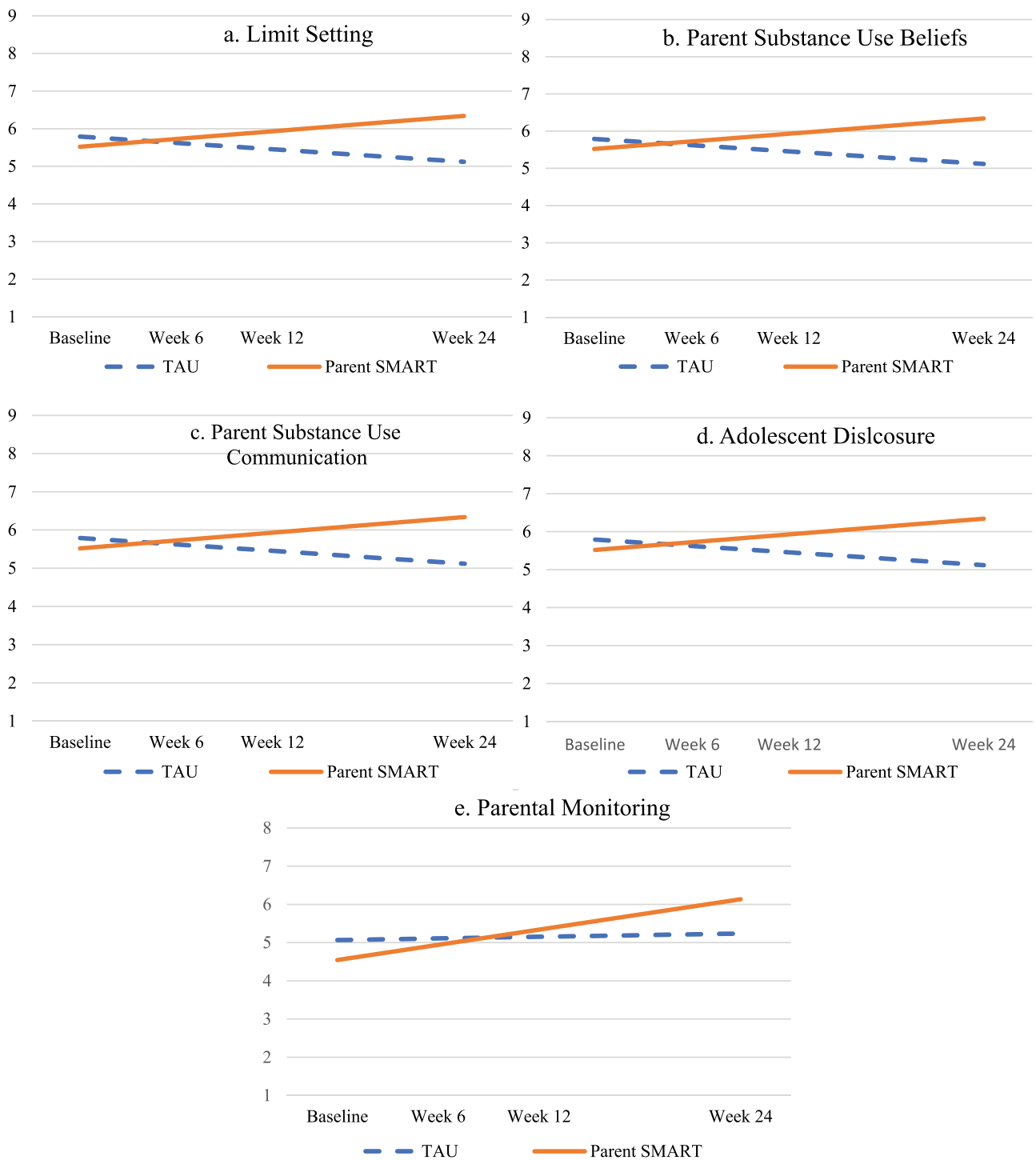


Figure 1. Effects of parent smart and treatment as usual on parenting processes over time, as observed via the behavioral interaction task.

behavioral measures of parental monitoring and parent-adolescent communication than those who received residential TAU only. Supplemental analyses by site uncovered additional effects on parent- and adolescent-reported questionnaires, with all outcomes favoring Parent SMART relative to

TAU. At the short-term facility, Parent SMART dyads improved on two participant-reported communication scales, whereas at the residential site, Parent SMART dyads improved on four of the five behavioral interaction tasks. Improvements corresponded with an X to Y increase in parenting skills,

and often represented a shift from moderate to strong parenting skills. Together, the findings highlight the value of using multi-modal assessment to detect change in parenting processes. The consistency of results also highlight Parent SMART's potential to improve parenting processes that protect against adolescent SU (Carroll et al., 2016; Tobler & Komro, 2010) during the transition from both short- and long-term residential care back to the community.

One key difference between the findings of the primary outcome analysis and the current secondary analyses bears note. In the primary outcome analysis, evidence of Parent SMART's effectiveness on adolescent substance use and substance-related problems was only detected at the short-term facility (Becker et al., 2021). By contrast, this secondary analysis found that Parent SMART was effective in improving parenting processes in both the short- and long-term residential facility. The services provided by the partner facilities may partially explain this differential pattern of results. Both facilities explicitly addressed adolescent SU via several hours of counseling per day. As a result, it might have been more difficult to detect the *additive* benefits of Parent SMART in the long-term residential facility, where adolescents had 30–45 days of SU-focused treatment, than in the short-term facility, where adolescents had only 6–10 days of treatment. By contrast, as is typical in adolescent residential services (Bohs, 2007), neither of the partner programs explicitly involved parents or addressed parenting skills. This might explain why we were able to detect benefits of Parent SMART on parenting across both settings: the difference in “dosage” likely did not translate to a major difference in the amount of targeted parenting support received by participants.

The present results are consistent with a growing body of research supporting the use of technology as part of youth SU treatment in general (Carreiro et al., 2018; Marsch & Borodovsky, 2016), and residential treatment in particular. For instance, Dennis et al. (2015) tested the use of a smartphone app for recovery monitoring and support among 29 adolescents recruited at discharge from residential treatment, and found that the app was feasible and that it provided timely opportunities for relapse prevention. Another set of studies by Gonzales and

colleagues (Gonzales et al., 2014, 2016) evaluated a mobile texting recovery program among 80 youth discharged from residential or outpatient SU treatment. These studies found that youth who received the technology-assisted intervention were less likely to relapse to their primary substance, and reported decreased SU severity and higher rates of engagement in recovery-related behaviors, relative to youth who received aftercare as usual. Parent SMART builds upon this foundational work by evaluating a technology-assisted intervention specifically for parents of adolescents in residential SU treatment. Whereas prior work has suggested that parents may require assistance using technology-assisted interventions (Ryan-Pettes et al., 2019), this was not a barrier in the current study. An intervention containing relatively few coaching sessions was found to effectively engage parents, many of whom worked full-time, and improve key parenting processes.

Though promising, these findings must be considered within the context of several limitations. The primary limitation was the small sample sizes at both facilities. While the small samples undoubtedly reduced the power to detect effects, the consistency of the direction and significance of effects across both pooled and stratified analyses bolsters confidence in the stability of the results. Another possible limitation pertains to the Parent SMART intervention. As a multi-component intervention, it is not feasible to determine which aspect of the intervention drove the observed effects. A third limitation pertains to the finding that only 50% of parents who were eligible for Parent SMART ultimately enrolled. This rate was driven in part by reliance on in-person intake procedures, which often limited the amount of time that residential staff had to discuss the project with eligible parents. Future work evaluating Parent SMART should leverage advances in remote consenting and enrollment, procedures which have become more commonplace during the COVID-19 pandemic (The Central Institutional Review Board for the National Cancer Institute, 2020), to more efficiently reach parents. As is common in parenting intervention studies, a fourth limitation was recruitment of predominantly mothers. A recent systematic review found that parenting studies targeting adolescent high-risk behavior typically had samples

comprised at least 85% mothers, highlighting the pervasive challenges engaging other caregivers in adolescent treatment. Efforts to engage parents in interventions in general and in Parent SMART in particular should prioritize the inclusion of fathers and other caregivers, including custodial guardians of adolescents placed in group homes, foster care, or juvenile justice detention settings. Finally, Parent SMART was piloted at one short-term facility and one long-term facility, and results should not be viewed as generalizable to all residential settings.

For clinical researchers and practitioners working in residential treatment settings, the results have several key implications. Most critically, results indicate that a relatively low-intensity technology-assisted intervention can engage parents of adolescents in residential SU treatment and improve parenting behaviors. Second, the findings support the value of multi-modal evaluation of parenting behaviors, since more improvements were detected on an observed behavioral interaction task than on adolescent- and parent-reported questionnaires. Finally, results suggest that the Parent SMART intervention merits further inquiry in a subsequent fully powered trial, with testing of parental monitoring and parent-adolescent communication as putative mediators of change. If further evidence of effectiveness and mediation were found in such a trial, Parent SMART could represent a novel and highly scalable adjunctive intervention in adolescent residential treatment settings. Such an intervention could have the potential to improve vital parenting processes during the vulnerable transition from residential care to the community.

Disclosure statement

No potential conflict of interest was reported by the authors.

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