Contemporary Clinical Trials 82 (2019) 106–114

Contents lists available at ScienceDirect

Contemporary Clinical Trials

journal homepage: www.elsevier.com/locate/conclintrial

A technology-augmented intervention to prevent peer violence and depressive symptoms among at-risk emergency department adolescents: Protocol for a randomized control trial

Megan L. Ranney[a,b,*], John V. Patena[b], Shira Dunsiger[c], Anthony Spirito[d], Rebecca M. Cunningham[e,g], Edward Boyer[f], Nicole R. Nugent[d]

[a] Department of Emergency Medicine, Alpert Medical School of Brown University, 55 Claverick Street 2nd Floor, Providence, RI 02903, United States
[b] Rhode Island Hospital, Department of Emergency Medicine, 593 Eddy Street, Providence, RI 02903, United States
[c] Department of Behavioral and Social Sciences, Brown University, Box G-5121-4, Providence, RI 02912, United States
[d] Department of Psychiatry and Human Behavior, Brown University, 700 Butler Drive, Providence, RI 02906, United States
[e] Department of Emergency Medicine, University of Michigan, 1500 East Medical Center Drive, Ann Arbor, MI 48109, United States
[f] Department of Emergency Medicine, University of Massachusetts Medical School, 55 Lake Avenue North, Worcester, MA 01655, United States
[g] University of Michigan Injury Prevention Center, University of Michigan School of Medicine, 2800 Plymouth Road, NCRC 10-G080, Ann Arbor, MI 48109, United States

ARTICLE INFO

Keywords:
Depression
Violence
Adolescent
mHealth
Text messaging
Prevention

ABSTRACT

Background: Peer violence and depressive symptoms are increasingly prevalent among adolescents, and for many, use the emergency department (ED) as their primary source of healthcare. Brief in-person interventions and longitudinal text-message-based interventions are feasible, acceptable, and may be effective in reducing peer violence and depressive symptoms when delivered in the ED setting. This paper presents the study design and protocol for an in-ED brief intervention (BI) and text messaging program (Text).

Methods: This study will be conducted in a pediatric ED which serves over 50,000 pediatric patients per year. Recruitment of study participants began in August 2018 and anticipated to continue until October 2021. The study will enroll 800 adolescents (ages13–17) presenting to the ED for any reason who self-report past-year physical peer violence and past-two week mild-to-moderate depressive symptoms. The study will use a factorial randomized trial to test both overall intervention efficacy and determine the optimal combination of intervention components. A full 2 × 2 factorial design randomizes patients at baseline to 1) BI or no BI; and 2) Text or no Text. Peer violence and depressive symptoms improvements will be measured at 2, 4, and 8 months through self-report and medical record review.

Discussion: This study has important implications for the progress of the greater field of mobile health interventions, as well as for adolescent violence and depression prevention in general. This proposal has high clinical and public health significance with high potential scalability, acceptability, and impact.

1. Introduction

Adolescents with a history of physical peer violence experience depressive symptoms at three times the rate of community peers [1–6]. Between 5 and 10% of adolescents in community samples reported past 30-day depressive symptoms [1,2,7] versus about 40% of adolescents with a history of peer violence [3–5,8]. Depressive symptoms likewise increase the risk of involvement in peer violence [9–16]. If unaddressed, these concurrent problems lead to increased risk of mental health disorders, substance use, and other risky behaviors [6,17–25].

The inter-related problems of peer violence and depressive symptoms are increasingly prevalent among adolescents, particularly among minority and low-income youth [26,27]. Emergency departments (ED) are often the only source of healthcare for these at-risk teens [28–32]. Higher rates of peer violence (40–50%), depressive symptoms (20–40%), and other mental health issues are reported among youth in the ED, regardless of the reason for their ED visit, compared to youth in schools or pediatric clinics [5,26,33–37]. Youth with a history of peer

* Corresponding author at: Address: 55 Claverick Street, 2nd Floor, Providence, RI 02903, United States.
E-mail addresses: Megan_Ranney@brown.edu (M.L. Ranney), John_Patena@alumni.brown.edu (J.V. Patena), SDunsiger@Lifespan.org (S. Dunsiger), Anthony_Spirito@brown.edu (A. Spirito), stroh@med.umich.edu (R.M. Cunningham), eboyer@bwh.harvard.edu (E. Boyer), Nicole_Nugent@brown.edu (N.R. Nugent).

https://doi.org/10.1016/j.cct.2019.05.009
Received 20 February 2019; Received in revised form 10 May 2019; Accepted 22 May 2019
Available online 23 May 2019
1551-7144/ © 2019 Elsevier Inc. All rights reserved.

violence and depressive symptoms are also more likely to have future ED visits for assault injuries [21,22,38]. ED screening for risk behaviors, including a history of violence, is supported as an important public health strategy [39–43].

Peer violence and depressive symptoms share common underlying mechanisms: deficits in cognitive reappraisal, emotional regulation, and self-efficacy skills [44–54]. These skill deficits are mutually reinforced by continued experiences of both peer violence and depressive symptoms [44,48,55,56]. Cognitive Behavioral Therapy (CBT) and Motivational Interviewing (MI) based interventions can address these skill deficits and prevent future peer violence and depressive symptoms [57–59]. Intensive case management programs for assault-injured youth, initiated in the ED or in the hospital, may also be effective at preventing future physical peer violence [60,61]. Multi-session CBT-based interventions decrease depressive symptoms and reduce incidence of major depression disorder, including among youth with a history of peer violence [62–70]. These interventions, however, require significant staff and time resources. At-risk racial, ethnic, and low-income youth are unlikely to access these preventive or therapeutic treatments due to both structural and personal barriers [7,22,71–74].

Brief in-person interventions and longitudinal text-message-based interventions, delivered in the ED setting to at-risk adolescents, are feasible, acceptable, and may be effective in reducing peer violence and depressive symptoms when theoretically-based, interactive, positive, and dynamically tailored [58,75–81]. Text messaging is a particularly accessible intervention modality: over 90% of adolescents have a mobile phone, 95% report owning or having access to a smartphone, and adolescents are constantly communicating via text and other mobile messaging platforms [82–86]. Text message interventions may have lower costs after the development phase, and may circumvent common barriers to accessing preventive interventions such as stigma and transportation [85,87–89]. Existing literature on text-messaging interventions is mixed regarding the need for human support (versus automated curricula), and the degree of tailoring and personalization needed [90–96]. If automated text messaging reduces peer violence and depressive symptoms, it could potentially be more easily disseminated than in-person interventions. Prior to dissemination, however, it is important to evaluate efficacy of these novel programs. [97,98].

2. Methods

2.1. Overview

Our previously completed pilot randomized control trial iDOVE [59] consisted of a brief intervention (BI): a 20-min CBT- and MI-based intervention during the ED visit; and an 8-week text intervention (Text): automated, tailored, two-way text-message curriculum started after the ED visit which reinforced cognitive appraisal, emotional regulation, and self-efficacy skills. The iDOVE pilot had excellent rates of recruitment (82% consenting) and retention (> 90% completing 4-month follow-up). In the study, 96% of recipients responded to at least one of the daily text messages, with a mean response rate of 84% (47 of 56 days received a response). iDOVE compared BI and Text interventions to a control group showing promising effect sizes in reducing peer violence ($d = 0.46$, $p = .01$) and depressive symptoms ($d = 0.37$, $p = .07$) at 8 weeks among youth with moderate symptoms at baseline. Teens whose daily mood had not improved by Day 7 of the Text intervention had poorer outcomes at follow-up and reported the need for in-the-moment “live” text support [59].

Automated text-message-based mood ratings correlate strongly with longitudinal depressive symptoms [99]. In iDOVE, latent class modeling was used to identify distinct subgroups of participants who showed similar patterns of daily text-message-based mood ratings over the course of the intervention. These patterns helped identify a subgroup of participants who are not improving in response to the intervention, and identify the critical time at which the divergence between improvers and non-improvers was evident. This characterization shows that text-based daily mood ratings are a well-operationalized, feasible marker of need for additional, “adaptive” intervention. Based on qualitative feedback provided by pilot participants [77], the pilot randomized control trial iDOVE [59], and others' studies [100–103], more personalized text messaging with a human counselor may be helpful for participants showing no signs of improvement via Text. Texting with a live counselor is highly acceptable to youth, as illustrated by the exponential growth of Crisis Text Line [104,105]. Use of human support is associated with improvements in outcomes in internet-based CBT prevention programs [106–109].

The primary aim of the current study, iDOVE2, is to test the efficacy of the components of iDOVE, an in-ED brief intervention (BI), automated text message intervention (Text), and adaptive, real-time texting (LiveText) components as developed in our pilot study, and to determine the most potent and parsimonious combination of these intervention components, using a factorial design, preventing peer violence and depressive symptoms among at-risk youth. The second aim is to examine the efficacy of the LiveText adaptive component among early non-responders (the subset of Text participants who do not show signs of improvement after 7–14 days). These participants will be re-randomized to either receive the supplementary LiveText intervention, or to continue with the standard Text intervention. Outcomes among the intervention groups will be compared to controls on peer violence and depressive symptoms over the course of follow-ups at 2, 4, and 8 months. A factorial design is a well-accepted strategy for optimizing behavioral interventions' components [110–112]. Factorial designs allow simultaneous testing of both main effects of, and interactions between, intervention components. Factorial designs also have high statistical efficiency, with a reduced number of experimental subjects needed compared to traditional trial design strategies [95,111–113]. The 2 × 2 factorial design used in this application will allow us to efficiently unpack which, if any, elements are most efficacious, and thereby design the most simple intervention [111,114].

Preliminary evidence shows intervention effects on changes in the putative participant-level mediators (cognitive reappraisal, emotional regulation, and self-efficacy skills). Formally testing whether changes in these mediators from baseline to 2-month follow-up mediate intervention effects on primary outcomes at subsequent follow-up time points will contribute to future efforts to design more effective preventive interventions [115,116]. Examining whether baseline participant characteristics (gender, baseline violence and depression severity, substance use, prior counseling) moderate intervention effects can identify subgroups who stand to benefit most from the intervention and thus will contribute to the science of developing targeted and tailored interventions. Finally, examining secondary effects (on other types of violence) may inform other adolescent violence prevention efforts.

2.2. Study design

iDOVE2 will enroll 800 adolescents (ages13–17) presenting to the ED for any reason who self-report past-year physical peer violence and past-two week mild-to-moderate depressive symptoms. The study will use a factorial randomized trial to test both overall intervention efficacy and determine the optimal combination of intervention components. A full 2 × 2 factorial design randomizes patients at baseline to 1) BI or no BI; and 2) Text or no Text. Text participants who do not show signs of improvement after 7–14 days (based on daily Text mood assessment) will be re-randomized to either 1) continue standard Text intervention; or 2) additionally receive LiveText, a more intensive text-message micro-counseling with a human interventionist. Peer violence and depressive symptoms improvements will be measured at 2, 4, and 8 months through self-report and medical record review. Fig. 1 illustrates the study's timeline.

The research protocol and informed consent process was approved by the hospital system's Institutional Review Board. A National

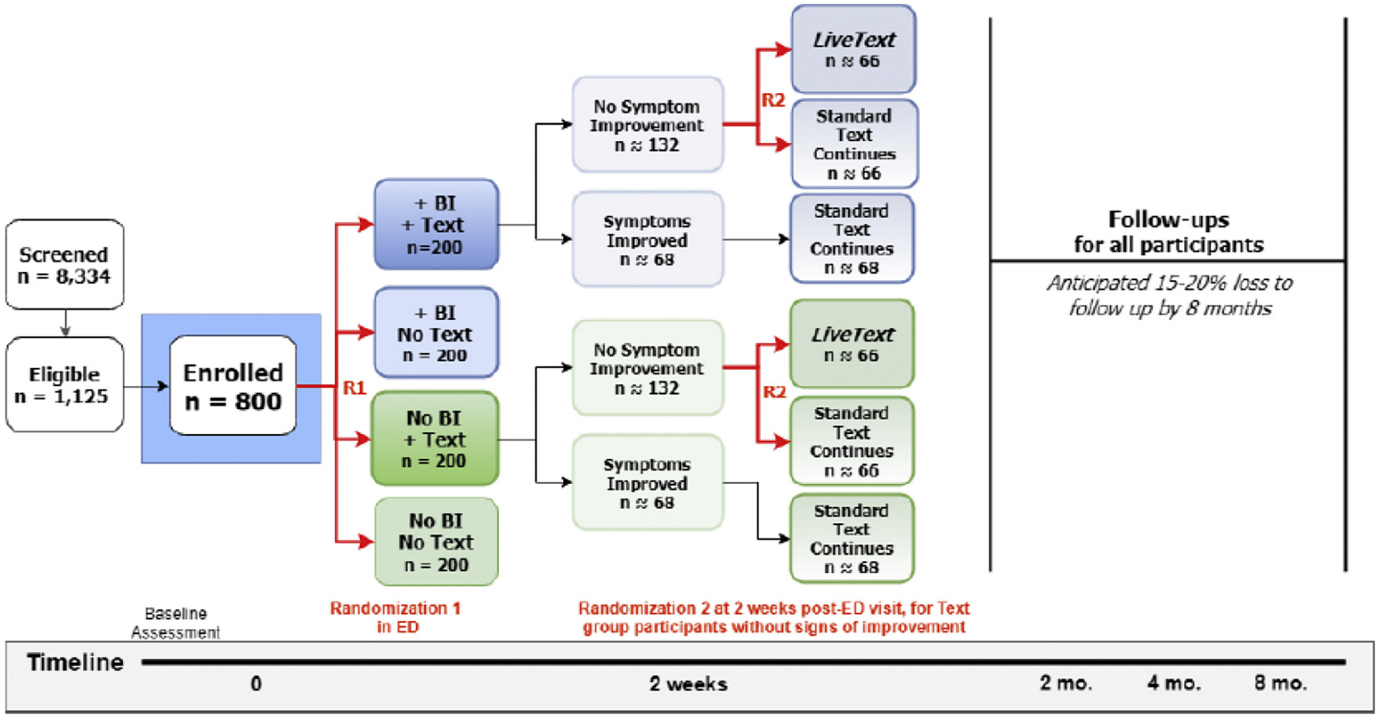

Fig. 1. Study timeline.

Institutes of Health (NIH) Certificate of Confidentiality was obtained before initiation of the study. A Data Safety and Monitoring Board was assembled using the institution's Research Committee and two external members.

2.3. Recruitment

This study will be conducted at the primary Level 1 trauma pediatric ED in a Northeast city which serves over 50,000 pediatric patients per year. The patient population is diverse, with about 30% publicly insured, 30% Hispanic, and 40% non-White race. Recruitment of study participants began in August 2018 and anticipated to continue until October 2021.

A Research Assistant (RA) will be present in the ED seven days a week from 1:00 pm – 9:30 pm in accordance with ED volume. Every patient meeting screening inclusion/exclusion criteria will be approached. Potentially eligible participants will be identified from the electronic ED tracker. After obtaining verbal parent consent and verbal adolescent assent, RAs will administer a computerized screening/baseline survey on a touch-screen tablet. Surveys will be conducted using Research Electronic Data Capture (REDCap) [117], a secure, web-based application designed to support data capture for research studies. All screened patients will be given a small gift (USD $1–2) as compensation for the screening. Computer-based assessments have been repeatedly shown to be more accurate than face-to-face questionnaires about risk behaviors [118].

Inclusion criteria for screening include: age 13–17, English speaking, and parent/guardian present. Exclusion criteria for screening include: chief complaint of suicidality, psychosis, sexual assault, child abuse; in police or child protective services custody; in need of emergency psychiatric care or evaluation; and being unable to assent. Participants are eligible for full study enrollment if they self-report: past-year physical peer violence using a modified version of the Conflicts Tactics Scale 2 (CTS2) [118]; past-two week mild-to-moderate depressive symptoms using the Patient Health Questionnaire 9 (PHQ9) [119–121]; and owning a text-message-capable cellphone. The CTS2 is a validated measure (a = 0.89–0.91) used in previous ED-based peer violence prevention interventions and asks about frequency of different types of physical victimization and perpetration [5,58,77,122,123]. To be eligible, participants must report ≥1 past-year on the CTS2. The PHQ9 is a standard, well-validated, clinically relevant screening tool for depressive symptoms [119–121]. To be eligible, participants must score between 5 and 19. This range accords with that used by other preventive intervention studies [5,77]. Participants who meet enrollment criteria will complete a written informed consent process and a contact information form.

2.4. Randomization

Participants will be randomized into one of four groups based on the factorial design: 1) Yes BI but No Text (“BI only”); 2) No BI but Yes Text (“Text only”); 3) Yes BI and Yes Text (“BI + Text”); and 4) No BI and No Text (“Control”). Randomization will be stratified by sex and baseline depressive symptoms, both known moderators of outcomes, using a block randomization procedure. The team's biostatistician will generate the randomization scheme based on a stratified permuted block randomization procedure, with small, random sized blocks (sizes 2–4). Study staff, except the RAs conducting recruitment and the Project Manager, will be blinded to randomization.

Depressive symptoms for randomization will be assessed using the Center for Epidemiologic Studies Depression scale-Revised (CESD-R), one of the most widely used assessments of depressive symptoms [124]. The CESD-R will be used for baseline and outcome measures instead of the PHQ9 score because of its greater validity and reliability. CESD-R cutoffs were chosen according to clinical cutoffs.

2.5. Intervention protocol

Each intervention component has been developed, iteratively refined, and piloted based on our theoretical model, existing CBT- and MI-based interventions, best practices for brief interventions and text-message interventions, expert consultation, and participant feedback [58,64,65,76–78,80,119]. Congruent with our theoretical model, each component emphasizes cognitive reappraisal, emotional regulation,

and self-efficacy skills.

Participants randomized to BI will receive a manualized, PowerPoint-guided, CBT- and MI-based intervention during the ED visit. Average ED visits are 3–5 h, and the BI was developed to be about 20 min. As described elsewhere [59], the intervention provides feedback, encourages goal-setting and reflection regarding self-efficacy on peer violence and depressive symptoms, and gives a brief introduction to basic CBT concepts (e.g. the thoughts-feelings-actions triangle, cognitive reappraisal, emotional regulation skills) and their connection to both peer violence and depressive symptoms. All in-ED BIs will be delivered by Bachelor's level-RAs and audio recorded for fidelity. The audio files will be assessed for adherence (based on session content) and competence (based on the Cognitive Therapy Rating Scale [125] and the Motivational Interviewing Treatment Integrity Code [57]). These scales will be used to rate the first ten BI recordings from each RA and 20% of interventions thereafter.

Participants randomized to Text will be briefly (about 3 min) oriented to the text-message system during the ED visit. For participants randomized to receive both interventions, the Text orientation will occur after completing the BI. The automated text message curriculum is tailored by gender and baseline peer violence level, as per text message intervention best practices [92,95,126–129]. Text content consists of: 1) Automated daily mood queries; 2) automated daily messages, tailored according to daily mood and baseline characteristics, that sequentially develop cognitive reappraisal, emotional regulation, and self-efficacy skills over the 8-week intervention; and 3) on-demand supportive messages which can be automatically pulled by the participant texting the keywords “stressed”, “sad”, “angry’, or “happy”. Text messages will be delivered to participants' own cell phones at the time of day that the participants prefer (outside of school hours), using an algorithm-guided automated text-message delivery system (programmed by GoMo Health, Asbury Park, NJ). For any responses deviating from expected parameters (e.g. 1–5 or an on-demand keyword), participants will receive an automated text-message instructing them to call a 24/7 mental health hotline, talk to a trusted adult, or call 911 in case of emergency. Text responses will be reviewed daily by study staff and address any concerns. All participants will receive a brochure containing information about the thoughts-feelings-actions triangle as an enhancement of standard care. Essentially, the Control group will only receive the brochure.

In addition to the standard Text curriculum, participants re-randomized into LiveText will also receive an automated message telling them they can get additional “live” support at designated times. The human text interventionist will be available to each participant once weekly, at different times of the day, to interact via text. The interventionist will provide the same basic content as Text in a more intensive and personalized format. Specifically, the interventionist will ask participants about current stressors (e.g. issues with school, relationships, friends/family), and then provide relevant reinforcement of cognitive reappraisal, emotional regulation, and self-efficacy skills drawn from the existing Text curriculum. Criteria to be re-randomized into LiveText are reporting no improvement in mood within 7–14 days of the Text program. No improvement in mood is defined as reporting a daily mood score below a 4 or not responding.

RAs will complete a one-day online MI training followed by instruction in the BI, Text, and LiveText protocols. RAs will also complete an 8-h in-person training sequence, listening to audio tapes of exemplar sessions from our previous pilot trial, followed by active role plays, until the RAs reach 80% fidelity criterion. Training will be provided by the Principal Investigator, Co-Investigators, and the Project Manager.

Maximum compensation for the entire trial is $140: $20 at baseline, $25 for 2-month follow-up, $30 for 4-month follow-up, and $40 for 8-month follow-up. Participants receiving Text will receive $10 per month for two months to cover text messaging costs. Participants who alert of us to a change in contact information will additionally receive $5.

RAs will be extensively trained to recognize and manage participant distress. If a participant reports suicidal ideation or meets criteria for severe depression in the screening/baseline survey or verbally discloses suicidal ideation or abuse in the ED, RAs will immediately notify the attending emergency physician. If mental health or other crises are identified during follow-up surveys or responses in text messages, the RAs will contact the Project Manager and a Co-Investigator who is “on call” to contact the participant, as per the study's crisis management plan. On-call Co-Investigators are licensed psychologists with expertise in adolescent trauma and psychopathology.

2.6. Measures

The assessment measures used in this study reflect high validity, reliability, and internal consistency and have been successfully used in prior protocols with ED-based research with adolescents [59,77]. Primary outcomes are physical peer violence as described above using the modified Conflict Tactics Scale 2 (CTS2) [118] and depressive symptoms as described above using the Center for Epidemiologic Studies Depression scale-Revised (CESD-R) [124].

Secondary outcomes include other forms of peer violence. Adolescent dating violence will be assessed using the Conflict in Adolescent Dating Relationships Inventory, physical subset (CADRI), a scale with high validity and reliability for teen dating violence [130]. Relational violence will be assessed using the Illinois Bully Scale (IBS), a validated self-report scale of bullying victimization and perpetration [131] with two additional questions from the Student School Survey (SSS) to assess cyberbullying [132]. Another secondary outcome is ED visits for peer assaults during the 12 months before and after enrollment, determined through chart reviews of enrolled patients.

Mechanisms: Cognitive reappraisal skills will be measured using the Emotional Regulation Questionnaire for Children and Adolescents, cognitive reappraisal subscale (ERQ−CA) which has strong construct and convergent validity [133]. Emotional regulation skills will be measured with the Self-Efficacy Questionnaire for Children, emotional self-efficacy subscale (SEQ-C) [134]. Violence self-efficacy will be measured using the Violence Self-Efficacy Scale [135].

Potential covariates include: use of psychological services using questions from the Child and Adolescent Services Assessment [136]; alcohol and other drug use using the short form of the NIDA-modified ASSIST [137]; and the presence of post-traumatic stress symptoms using the Primary Care-PTSD scale [138]. Although this study does not specifically target behavioral activation or social support in the intervention, these entities may be affected by a CBT-based intervention and will therefore measure social support using the Multidimensional Scale of Perceived Social Support (MSPSS) [139,140]. Finally, sociodemographic variables including race, ethnicity, family poverty, and academic performance will be measured using the National Study on Adolescent Health [141], with additional questions on gender identity from the Gender Identity in U.S. Surveillance group [142].

2.7. Analytic strategies

Sample size was calculated with the goal of achieving sufficient power (> 80%) to detect significant main effects of intervention components on peer violence and depressive symptoms, as well as the interaction between them [113,143,144]. These calculations accounted for theorized differences between BI, Text, and BI + Text groups, as well as theorized differences between LiveText and standard Text. Sample size was determined using the *pwr* package in R (cran.r-project.org). To our knowledge, with the exception of our prior pilot study [59], no single published study evaluates the effects of BI + Text on peer violence and depressive symptoms in youth, nor the differences between LiveText and standard Text on these outcomes. Consistent with expert opinion [145,146], we therefore integrated several sources of evidence to determine an expected effect size for the proposed iDOVE2 study.

First, we considered the between group differences on peer violence and depressive symptoms in our pilot ($d = 0.46$ and $d = 0.37$ respectively) [59]. Second, we considered other published trials of brief interventions for peer violence and depression, which includes a study of a brief computerized intervention for violence among teens (RR = 0.70 at 6 months) [123]. Third, we considered meta-analytic evidence from Hetrick and colleagues on CBT-based adolescent depression prevention, indicating a standardized mean difference of −0.31 at 3 months [147]. Other studies suggest that the difference between LiveText and standard Text will be in the small-medium range (d = 0.25) [106–109]. Taken together, given effects at least as large as those presented above, and an alpha level of 0.05, a total sample size of 800 participants would be required in order to have sufficient (80%) power to test the longitudinal effect of the intervention and its components on peer violence and depressive symptoms among the intent-to-treat sample, as well as to complete the planned subgroup analyses. This sample will also be more than sufficient (power > 80%) to detect medium effect size for moderator ($f^2 = 0.15$) and mediator outcomes ($f^2 = 0.09$), even conservatively accounting for up to 20% attrition. All analysis will be conducted on the intent to treat sample, thus including all participants randomized at baseline.

After study recruitment has been completed, as a preliminary step, we will assess potential between-group differences in baseline characteristics (demographics and socio-economic status, including sex and gender; baseline peer violence; baseline depressive symptoms; and other psychosocial factors) using graphical methods and non-parametric and parametric tests as appropriate (e.g., Wilcoxon rank-sum test for skewed data, *t*-tests for normally distributed continuous data, and chi-squared tests for categorical data). Any variables not balanced by randomization will be controlled for as covariates in subsequent analyses. The distribution of outcome variables will be assessed, and if needed, transformed prior to subsequent analyses.

After study follow-up has been completed, to test the efficacy of the main iDOVE2 components on the primary outcomes (peer violence and depressive symptoms), we will use a series of mixed effects longitudinal regression models, in which the outcome at each follow-up (2, 4, and 8 months) is simultaneously regressed on time, BI, Text, BI x Text, time x BI, time x Text and time x BI x Text, controlling for baseline value of the outcome. Note that each effect estimate will maintain the power associated with all 800 subjects [110–113]. As per best practices for analysis of factorial design, for example, the main effect of the BI component will be tested by comparing the mean of the outcome variable for the 400 subjects who receive BI (i.e., those in "BI only" and "BI + Text") versus the mean of the outcome variable for the 400 subjects who do not receive BI (i.e., those in "Text only" and "Control" groups). Models will include a random intercept to adjust for correlated responses over time within participant and will adjust for any variables not balanced by randomization.

The effects of potentially co-varying symptom complexes (for example, PTSD symptoms) will also be explored on the primary outcomes using a similar analytic approach to that described above. Should outcome variables be skewed, and attempts to transform towards normality unsuccessful, we will examine intervention effects on median outcome values at follow-up adjusting for baseline using a series of quantile regression models. As a secondary analysis, we will examine efficacy on incidence of other forms of peer violence (physical dating violence, bullying, and ED visits for assault), using a longitudinal regression model implemented with Generalized Estimating Equations with robust standard errors. Specifically, we will regress the probability of physical dating violence, bullying, and ED visits for assault, respectively, on time, BI, Text, BI x Text, time x BI, time x Text and time x BI x Text, using a logit link function.

We will examine the efficacy of the embedded adaptive intervention using a similar analytic approach to that described for the first aim. First, we will compare responders (with reduced physical peer violence and reduced depressive symptoms) and non-responders, as well as treatment groups (LiveText vs. standard Text), with respect to baseline variables, including demographics and baseline values of the outcome. Any variables not balanced by randomization will be treated as covariates in the regression models. Then, using a series of mixed effects regression models (as described above), we will estimate effects of group on outcomes over time. Specifically, a series of mixed effects models will estimate the effects of condition on peer violence and depressive symptoms over time. At the broadest level, we can estimate the LiveText effect by recoding the text effect such that it is a two-level variable (LiveText vs. standard Text). Similar to the recoding for main effects in Aim 1, we will be able to combine all LiveText participants into a single analytic group. Thus, the model will be able to estimate the effects separately for the LiveText and standard Text conditions and, as described above, is adequately powered to do so.

We will examine potential mediators and moderators of the intervention effects on both primary outcomes. Potential moderators include gender, baseline violence, baseline substance use, delinquency, and use of mental health counseling services. These will be explored using a series of regression models similar to those described in Aims 1 and 2. Models will include main effects of intervention component (for Aim 1) and group (for Aim 2), moderator, time and the interactions between them. A variable will be considered a moderator if the interaction between intervention component/group and the moderator is significantly different from zero. Potential mediators of the intervention effects include cognitive reappraisal skills, emotional regulation skills, and self-efficacy, and will be assessed using a series of multiple mediation models with bootstrapped standard errors. For example, mediators of the intervention effect on peer violence at follow-ups will be assessed using a multiple mediation approach, in which all potential mediators are tested simultaneously using a product of coefficients method [144], with bootstrapped standard errors (5000 samples with replacement). We will estimate the path coefficients (*a* path: effects of intervention components on changes in mediators from baseline to 2 months and *b* path: effects of changes in the mediators on peer violence at later follow-ups), as well as the indirect effect of intervention (*ab* path: effect of intervention components on outcomes through the mediators). Interest is in estimating the path coefficients, effect sizes, and confidence intervals. A similar approach will be used for identifying mediators of intervention components on depressive symptoms.

In our prior work, we have retained 85–90% of participants at 12-month follow-up. In the case that a participant drops out of the program, we will attempt to gather follow-up information. If a participant refuses to be contacted or otherwise loses contact with the research staff, we will censor the data at the point of loss. Our analyses will focus on the intent to treat sample, meaning that all participants randomized will be included in the analysis, regardless of the amount of data they contribute. Analysis will use estimating equations and maximum likelihood (ML) approaches to produce estimates of the regression parameters. One advantage of a ML approach is that it makes use of all available data without requiring imputation of missing values. ML estimates have been shown to be consistent when missing data is related only to covariates and observed values of the outcome [148]. As it is possible (although not testable) that missingness may be related to the missing outcome itself (e.g., not random), we will run a sensitivity analysis to explore the robustness of our findings to other assumptions of the missing data.

For data collection, we will specifically use REDCap [117]. The REDCap system provides secure, web-based applications that can be used for research and operational support purposes. It provides an intuitive interface for users to enter data with real-time validation rules (with automated data type and range checks) at the time of entry. It also allows automatic extraction of information from the electronic health record. These systems offer easy data manipulation with audit trails for reporting, monitoring and querying patient records, and an automated export mechanism to common statistical packages (SPSS, SAS, Stata, R/S-Plus). REDCap servers are housed in a local data center

at Lifespan and information transmission is encrypted. REDCap was developed specifically to conform to HIPAA Security guidelines, and has been extensively used by our research team in prior work.

3. Results

iDOVE2 is funded from March 2018 – February 2023 by the National Institute of Child Health and Human Development (R01 HD093655) with recruitment planned to continue until October 2021. The study is currently registered on ClinicalTrials.gov (ID: NCT03626103). Preliminary findings will be published in journals within one year of study completion, per NIH guidelines.

4. Discussion

4.1. Design considerations

As iDOVE2 was developed, we considered alternatives. Detailed below is our rationale for the present design:

Why past-year peer (non-partner) physical violence? Our work and others' shows that peer physical violence perpetration and victimization are highly overlapping [20,149]. Moreover, teens with *any* past-year physical fights (not just those with acute injury) are high risk for future injury and depressive symptoms [6,150,151]. Our work and others' supports using the ED visit as a moment to screen and intervene with at-risk patients [39–43,152]. Dating (partner) violence and non-physical violence (bullying/cyberbullying) are related but distinct types of adolescent violence with different underlying mechanisms and consequently, will not be used as inclusion criteria [151,153–155]. We will, however, measure them at baseline and follow-ups.

Why not an app? Although mobile applications ("apps"), such as games have promise, their utility is limited in our at-risk population. Almost all adolescents (~90%) have mobile phones with text-messaging, versus only ~70% with smartphones (capable of mobile application deployment) [82,83,156]. Text-message behavioral interventions have high rates of being read and retained, and higher acceptability and feasibility than app-based health interventions among adolescents [157,158]. Additionally, the cost of developing an app for both iOS and Android platforms, and keeping it updated, may limit long-term ability to disseminate the intervention.

Why no peer networking? Although social interactions increase engagement in many types of behavioral interventions [159,160], given the sensitive nature of this intervention's topic, and the potential for violence retaliation among participants, social networking would not be appropriate for this intervention.

Why no parental involvement? From a developmental perspective, adolescent-focused interventions are most appropriate for this age group (13–17 year olds); our prior work supports parental acceptance of in-ED interventions for at-risk youth when content focuses on teens alone [33,58,77,78,161].

Why "LiveText" instead of a traditional booster, stepped care, or other intervention? For this age group, texting is a more appropriate preventive intervention for adolescents than a phone call or in-person session. Text interactions also have higher acceptability and feasibility, and may have higher efficacy than mixed-modality preventive interventions [162]. A structured text interaction, reinforcing Text and BI content, is strongly supported by the previously articulated needs of iDOVE pilot participants [77,78,80], as well as others' studies [100–102].

Why deliver the adaptive intervention only to Text participants? Daily assessments of mood may, in and of themselves, influence ability to identify and regulate emotions [163,164]. Without this daily Text assessment of non-Text participants, we cannot reliably identify whether non-Text participants show signs of "no improvement," and could not reliably re-randomize them.

How does iDOVE2 relate to in-person counseling? The iDOVE2 intervention is purposefully designed as a supplement to, rather than substitute for, usual care. It is explicitly a preventive, not therapeutic, intervention. We will conduct exploratory analyses examining whether the intervention increases use of in-person counseling, and whether use of in-person treatment moderates effect.

4.2. Impact and future directions

The development and validation of technology-augmented preventive interventions is still in its infancy. Although text-message interventions are highly accessible to adolescents, a potential challenge is sustainability, especially when patients are recruited from the ED, where patients may have higher rates of changing their number or losing a cell phone plan [165]. Additionally, given the large cumulative burden of traumatic life events and mental health problems in this population, a stepped-care intervention may be more appropriate than simpler, "one-size-fits-all" interventions [166,167]. This study therefore has important implications for the progress of the greater field of mobile health interventions, as well as for adolescent violence and depression prevention in general.

At the completion of this study, we hope to have defined: 1) The efficacy of the iDOVE2 intervention components, 2) the relative efficacy of the LiveText intervention with human counselors, and 3) mediators and moderators of intervention effect. Depending on study results, we will either have a simple, validated intervention addressing a major adolescent public health issue, or scientifically important information about how and why the individual iDOVE2 intervention components were not successful. If the study results are positive, the expected next step would be an effectiveness trial. If the study results show a null effect of all intervention components, the data will nonetheless inform future intervention development efforts. This study therefore represents an important contribution to the literature on violence prevention for at-risk youth.

This proposal has high clinical and public health significance, testing the efficacy of an intervention with potentially high scalability, acceptability, and impact. It is innovative in determining which, if any, intervention components have efficacy, and for whom. If all or part of the intervention components show efficacy, the next step would be to determine effectiveness and ease of dissemination [98]. Regardless of efficacy, this will advance the NIH-wide objectives of improved understanding of personalized intervention mechanisms [168,169]. Accessible, easily disseminable interventions for these at-risk teens are a public health imperative to prevent future violence and related disorders [6,17–25].

Conflict of interests

None.

Funding

This work was supported by the National Institutes of Health [R01HD093655].

References

[1] R.C. Kessler, E.E. Walters, Epidemiology of DSM-III-R major depression and minor depression among adolescents and young adults in the national comorbidity survey, Depress Anxiety 7 (1) (1998) 3–14.
[2] P.M. Lewinsohn, et al., Adolescent psychopathology: I. prevalence and incidence of depression and other DSM-III-R disorders in high school students, J. Abnorm. Psychol. 102 (1) (1993) 133–144.
[3] M.L. Ranney, et al., Sex differences in characteristics of adolescents presenting to the emergency department with acute assault-related injury, Acad. Emerg. Med. 18 (10) (2011) 1027–1035.
[4] M.H. Biros, et al., Occult depressive symptoms in adolescent emergency department patients, Arch. Pediatr. Adolesc. Med. 162 (8) (2008) 769–773.
[5] M.L. Ranney, et al., Correlates of depressive symptoms among at-risk youth

presenting to the emergency department, Gen. Hosp. Psychiatry 35 (5) (2013) 537–544.
[6] M.L. Ranney, et al., PTSD, cyberbullying and peer violence: prevalence and correlates among adolescent emergency department patients, Gen. Hosp. Psychiatry 39 (2016) 32–38.
[7] Substance Abuse and Mental Health Services Administration, Behavioral health barometer: United States, 2015, (2015) (Rockville, MD).
[8] D.A. Obeidallah, F.J. Earls, Adolescent Girls: The Role of Depression in the Development of Delinquency, National Institute of Justice, Washington, DC, 1999.
[9] I.W. Borowsky, M. Ireland, Predictors of future fight-related injury among adolescents, Pediatrics 113 (3) (2004) 530–536 Pt 1.
[10] C.A. Cuevas, et al., Psychological distress as a risk factor for re-victimization in children, Child Abuse Negl. 34 (4) (2010) 235–243.
[11] S. Diamantopoulou, F.C. Verhulst, J. van der Ende, Gender differences in the development and adult outcome of co-occurring depression and delinquency in adolescence, J. Abnorm. Psychol. 120 (3) (2011) 644–655.
[12] C. Ebesutani, E. Kim, J. Young, The role of violence exposure and negative affect in understanding child and adolescent aggression, Child Psychiatry Hum. Dev. 45 (6) (2014) 736–745.
[13] S. Fazel, et al., Depression and violence: a Swedish population study, Lancet Psychiatry 2 (3) (2015) 224–232.
[14] C.J. Ferguson, C. San Miguel, R.D. Hartley, A multivariate analysis of youth violence and aggression: the influence of family, peers, depression, and media violence, J. Pediatr. 155 (6) (2009) 904–908 (e3).
[15] W.L. Robinson, K.C. Paxton, L.P. Jonen, Pathways to aggression and violence among African American adolescent males: the influence of normative beliefs, neighborhood, and depressive symptomatology, J. Prev. Interv. Community 39 (2) (2011) 132–148.
[16] F. Turcotte Benedict, et al., Emergency department utilization among assault-injured youth: implications for youth violence screening, Pediatr. Emerg. Care 33 (9) (2017 Sep) 607–612.
[17] S.D. Hillis, J.A. Mercy, J.R. Saul, The enduring impact of violence against children, Psychology, Health & Medicine 22 (4) (2017) 393–405.
[18] D.N. Klein, et al., Subthreshold depressive disorder in adolescents: predictors of escalation to full-syndrome depressive disorders, J. Am. Acad. Child Adolesc. Psychiatry 48 (7) (2009) 703–710.
[19] D.M. Fergusson, et al., Subthreshold depression in adolescence and mental health outcomes in adulthood, Arch. Gen. Psychiatry 62 (1) (2005) 66–72.
[20] T.N. Sullivan, A.D. Farrell, W. Kliewer, Peer victimization in early adolescence: association between physical and relational victimization and drug use, aggression, and delinquent behaviors among urban middle school students, Dev. Psychopathol. 18 (1) (2006) 119–137.
[21] R.M. Cunningham, et al., Violent reinjury and mortality among youth seeking emergency department care for assault-related injury: a 2-year prospective cohort study, JAMA Pediatr. 169 (1) (2015) 63–70.
[22] K.M. Bohnert, et al., Understanding the service needs of assault-injured, drug-using youth presenting for care in an urban emergency department, Addict. Behav. 41 (2015) 97–105.
[23] L. Bowes, et al., Peer victimisation during adolescence and its impact on depression in early adulthood: prospective cohort study in the United Kingdom, BMJ 350 (2015) (p. h2469).
[24] J.M. Cisler, et al., Exposure to interpersonal violence and risk for PTSD, depression, delinquency, and binge drinking among adolescents: data from the NSA-R, J. Trauma. Stress. 25 (1) (2012) 33–40.
[25] S. Miller, et al., Developmental trajectories of boys' and girls' delinquency: sex differences and links to later adolescent outcomes, J. Abnorm. Child Psychol. 38 (7) (2010) 1021–1032.
[26] R. Mojtabai, M. Olfson, B. Han, National trends in the prevalence and treatment of depression in adolescents and young adults, Pediatrics 138 (6) (2016).
[27] Centers for Disease Control and Prevention (CDC), National Center for Injury Prevention and Control, Web-based Injury Statistics Query and Reporting System (WISQARS). (online). Available from URL: www.cdc.gov/ncipc/wisqars. 2014.
[28] K.M. Wilson, J.D. Klein, Adolescents who use the emergency department as their usual source of care, Arch. Pediatr. Adolesc. Med. 154 (4) (2000) 361–365.
[29] J.A. Sabin, et al., Primary care utilization and detection of emotional distress after adolescent traumatic injury: identifying an unmet need, Pediatrics 117 (1) (2006) 130–138.
[30] C.E. Snider, J.S. Lee, Emergency department dispositions among 4100 youth injured by violence: a population-based study, CJEM 9 (3) (2007) 164–169.
[31] A. Wells, et al., Barriers to depression treatment among low-income, latino emergency department patients, Community Ment. Health J. 49 (4) (2013) 412–418.
[32] S. Ali, et al., Temporal trends in pediatric mental health visits: using longitudinal data to inform emergency department health care planning, Pediatr. Emerg. Care 28 (7) (2012) 620–625.
[33] A. Riese, et al., Prompting discussions of youth violence using electronic previsit questionnaires in primary care: a cluster randomized trial, Acad. Pediatr. 15 (3) (2015) 345–352.
[34] E.G. Scott, et al., Screening for adolescent depression in a pediatric emergency department, Acad. Emerg. Med. 13 (5) (2006) 537–542.
[35] M.E. Pailler, et al., Depression, acute stress and behavioral risk factors in violently injured adolescents, Gen. Hosp. Psychiatry 29 (4) (2007) 357–363.
[36] M.S. Rutman, E. Shenassa, B.M. Becker, Brief screening for adolescent depressive symptoms in the emergency department, Acad. Emerg. Med. 15 (1) (2008) 17–22.
[37] K.R. Merikangas, et al., Prevalence and treatment of mental disorders among US children in the 2001-2004 NHANES, Pediatrics 125 (1) (2010) 75–81.
[38] N.K. Gaylord-Harden, et al., Examining the pathologic adaptation model of community violence exposure in male adolescents of color, J. Clin. Child Adolesc. Psychol. (2016) 1–11.
[39] S.L. Bernstein, G. D'Onofrio, Public health in the emergency department: academic emergency medicine consensus conference executive summary, Acad. Emerg. Med. 16 (11) (2009) 1037–1039.
[40] M.L. Ranney, et al., A consensus-driven agenda for emergency medicine firearm injury prevention research, Ann. Emerg. Med. 69 (2) (2017) 227–240.
[41] S.C. Rogers, et al., Can a youth violence screening tool be used in a Pediatric emergency department setting? J. Trauma Acute Care Surg. 73 (4) (2012) Suppl 3. (p. S243–7).
[42] M.A. Walton, et al., Components of brief alcohol interventions for youth in the emergency department, Subst. Abus. 36 (3) (2015) 339–349.
[43] E.D. Boudreaux, et al., Improving suicide risk screening and detection in the emergency department, Am. J. Prev. Med. 50 (4) (2016) 445–453.
[44] J.S. Silk, L. Steinberg, A.S. Morris, Adolescents' emotion regulation in daily life: links to depressive symptoms and problem behavior, Child Dev. 74 (6) (2003) 1869–1880.
[45] J.M. Shadur, C.W. Lejuez, Adolescent substance use and comorbid psychopathology: emotion regulation deficits as a Transdiagnostic risk factor, Curr. Addict. Rep. 2 (4) (2015) 354–363.
[46] B. Ali, C.J. Seitz-Brown, S.B. Daughters, The interacting effect of depressive symptoms, gender, and distress tolerance on substance use problems among residential treatment-seeking substance users, Drug Alcohol Depend. 148 (2015) 21–26.
[47] C.A. Vasilev, et al., Correspondence between physiological and self-report measures of emotion dysregulation: a longitudinal investigation of youth with and without psychopathology, J. Child Psychol. Psychiatry 50 (11) (2009) 1357–1364.
[48] N.K. Gaylord-Harden, et al., Examining the effects of emotional and cognitive desensitization to community violence exposure in male adolescents of color, Am. J. Orthop. 87 (4) (2017) 463–473.
[49] J.L. Hamilton, et al., Deficits in emotional clarity and vulnerability to peer victimization and internalizing symptoms among early adolescents, J. Youth Adolesc. 45 (1) (2016) 183–194.
[50] K.A. McLaughlin, M.L. Hatzenbuehler, L.M. Hilt, Emotion dysregulation as a mechanism linking peer victimization to internalizing symptoms in adolescents, J. Consult. Clin. Psychol. 77 (5) (2009) 894–904.
[51] K.R. Sinclair, et al., Impact of physical and relational peer victimization on depressive cognitions in children and adolescents, J. Clin. Child Adolesc. Psychol. 41 (5) (2012) 570–583.
[52] S. Fergus, M.A. Zimmerman, Adolescent resilience: a framework for understanding healthy development in the face of risk, Annu. Rev. Public Health 26 (2005) 399–419.
[53] C.L. Gibson, A.A. Fagan, K. Antle, Avoiding violent victimization among youths in urban neighborhoods: the importance of street efficacy, Am. J. Public Health 104 (2) (2014) (p. e154–61).
[54] D.A. Cole, et al., Linking peer victimization to the development of depressive self-schemas in children and adolescents, J. Abnorm. Child Psychol. 42 (1) (2014) 149–160.
[55] N.N. Duke, I.W. Borowsky, Youth violence prevention and safety: opportunities for health care providers, Pediatr. Clin. N. Am. 62 (5) (2015) 1137–1158.
[56] A. Kercher, R.M. Rapee, A test of a cognitive diathesis-stress generation pathway in early adolescent depression, J. Abnorm. Child Psychol. 37 (6) (2009) 845–855.
[57] T.B. Moyers, et al., Assessing competence in the use of motivational interviewing, J. Subst. Abus. Treat. 28 (1) (2005) 19–26.
[58] R.M. Cunningham, et al., Brief motivational interviewing intervention for peer violence and alcohol use in teens: one-year follow-up, Pediatrics 129 (6) (2012) 1083–1090.
[59] M.L. Ranney, et al., Emergency department text messaging for adolescent violence and depression prevention: a pilot randomized controlled trial, Psychol. Serv. 15 (4) (2018) 419–428.
[60] M.A. Limbos, et al., Effectiveness of interventions to prevent youth violence a systematic review, Am. J. Prev. Med. 33 (1) (2007) 65–74.
[61] D. Shibru, et al., Benefits of a hospital-based peer intervention program for violently injured youth, J. Am. Coll. Surg. 205 (5) (2007) 684–689.
[62] S. Merry, et al., A randomized placebo-controlled trial of a school-based depression prevention program, J. Am. Acad. Child Adolesc. Psychiatry 43 (5) (2004) 538–547.
[63] E. Stice, et al., Efficacy trial of a brief cognitive-behavioral depression prevention program for high-risk adolescents: effects at 1- and 2-year follow-up, J. Consult. Clin. Psychol. 78 (6) (2010) 856–867.
[64] E. Stice, et al., Brief cognitive-behavioral depression prevention program for high-risk adolescents outperforms two alternative interventions: a randomized efficacy trial, J. Consult. Clin. Psychol. 76 (4) (2008) 595–606.
[65] J. Garber, et al., Prevention of depression in at-risk adolescents: a randomized controlled trial, JAMA 301 (21) (2009) 2215–2224.
[66] B.D. Stein, et al., A mental health intervention for schoolchildren exposed to violence: a randomized controlled trial, JAMA 290 (5) (2003) 603–611.
[67] E. Stice, et al., A meta-analytic review of depression prevention programs for children and adolescents: factors that predict magnitude of intervention effects, J. Consult. Clin. Psychol. 77 (3) (2009) 486–503.
[68] G.N. Clarke, et al., Targeted prevention of unipolar depressive disorder in an at-risk sample of high school adolescents: a randomized trial of a group cognitive intervention, J. Am. Acad. Child Adolesc. Psychiatry 34 (3) (1995) 312–321.
[69] S.H. Kataoka, et al., A school-based mental health program for traumatized Latino immigrant children, J. Am. Acad. Child Adolesc. Psychiatry 42 (3) (2003)

311–318.
[70] S.R. Shirk, et al., Cognitive behavioral therapy for depressed adolescents exposed to interpersonal trauma: an initial effectiveness trial, Psychotherapy (Chic) 51 (1) (2014) 167–179.
[71] J. Bisgaier, K.V. Rhodes, Auditing access to specialty care for children with public insurance, N. Engl. J. Med. 364 (24) (2011) 2324–2333.
[72] P.L. Owens, et al., Barriers to children's mental health services, J. Am. Acad. Child Adolesc. Psychiatry 41 (6) (2002) 731–738.
[73] A. Sylwestrzak, et al., Self-reported barriers to treatment engagement: adolescent perspectives from the National Comorbidity Survey-Adolescent Supplement (NCS-A), Community Ment. Health J. 51 (7) (2015) 775–781.
[74] K.R. Merikangas, et al., Service utilization for lifetime mental disorders in U.S. adolescents: results of the National Comorbidity Survey-Adolescent Supplement (NCS-A), J. Am. Acad. Child Adolesc. Psychiatry 50 (1) (2011) 32–45.
[75] M.L. Ranney, et al., Effects of a brief ED-based alcohol and violence intervention on depressive symptoms, Gen. Hosp. Psychiatry 46 (2017) 44–48.
[76] M.M. Thorsen, et al., Using high-risk adolescents' voices to develop a comprehensible cognitive behavioral therapy-based text-message program, Behav. Med. (2016) 1–11.
[77] M.L. Ranney, et al., A depression prevention intervention for adolescents in the emergency department, J. Adolesc. Health 59 (4) (2016).
[78] M.L. Ranney, et al., "You need to get them where they feel it": conflicting perspectives on how to maximize the structure of text-message psychological interventions for adolescents, Proc. Annu. Hawaii Int. Conf. Syst. Sci. (2015) 3247–3255.
[79] R.K. Rosen, M. Ranney, E.W. Boyer, Formative research for mhealth HIV adherence: the iHAART app, Proc. Annu. Hawaii Int. Conf. Syst. Sci. (2015) 2779–2785.
[80] M.L. Ranney, et al., Acceptability, language, and structure of text message-based behavioral interventions for high-risk adolescent females: a qualitative study, J. Adolesc. Health 55 (1) (2014) 33–40.
[81] E. Choo, et al., "I need to hear from women who have 'been there'": developing a woman-focused intervention for drug use and partner violence in the emergency department, Partner Abuse 7 (2) (2016) 193–220.
[82] A. Lenhart, Teens, Social Media & Technology Overview 2015, Pew Research Center, 2015.
[83] M.L. Ranney, et al., Emergency department patients' preferences for technology-based behavioral interventions, Ann. Emerg. Med. 60 (2) (2012) 218–227 (e48).
[84] M.L. Ranney, et al., Adolescents' preference for technology-based emergency department behavioral interventions: does it depend on risky behaviors? Pediatr. Emerg. Care 29 (4) (2013) 475–481.
[85] S. Kumar, et al., Mobile health technology evaluation: the mHealth evidence workshop, Am. J. Prev. Med. 45 (2) (2013) 228–236.
[86] M. Anderson, J. Jiang, Teens, Social Media, & Technology 2018, Pew Research Center, 2018.
[87] W.T. Riley, et al., Mobile and wireless technologies in health behavior and the potential for intensively adaptive interventions, Curr. Opin. Psychol. 5 (2015) 67–71.
[88] A. Atienza, K. Patrick, Mobile health: the killer app for cyberinfrastructure and consumer health, Am. J. Prev. Med. 40 (5) (2011) Suppl 2. (p. S151–3).
[89] C. Archangeli, et al., Mobile health interventions for psychiatric conditions in children: a scoping review, Child Adolesc. Psychiatr. Clin. N. Am. 26 (1) (2017) 13–31.
[90] E. Wu, J. Torous, G. Harper, A gap in the literature: clinical role for smartphone applications for depression care among adolescents? J. Am. Acad. Child Adolesc. Psychiatry 55 (7) (2016) 630–631.
[91] R. Gonzales, et al., Youth recovery outcomes at 6 and 9 months following participation in a mobile texting recovery support aftercare pilot study, Am. J. Addict. 25 (1) (2016) 62–68.
[92] A.K. Hall, H. Cole-Lewis, J.M. Bernhardt, Mobile text messaging for health: a systematic review of reviews, Annu. Rev. Public Health 36 (2015) 393–415.
[93] Y. Seko, et al., Youth mental health interventions via mobile phones: a scoping review, Cyberpsychol. Behav. Soc. Netw. 17 (9) (2014) 591–602.
[94] S. Konrath, et al., Can text messages increase empathy and prosocial behavior? The development and initial validation of text to connect, PLoS One 10 (9) (2015) (p. e0137585).
[95] K.J. Head, et al., Efficacy of text messaging-based interventions for health promotion: a meta-analysis, Soc. Sci. Med. 97 (0) (2013) 41–48.
[96] L. O'Rourke, G. Humphris, A. Baldacchino, Electronic communication based interventions for hazardous young drinkers: a systematic review, Neurosci. Biobehav. Rev. 68 (2016) 880–890.
[97] R.E. Glasgow, et al., Practical clinical trials for translating research to practice: design and measurement recommendations, Med. Care 43 (2005) 551–557.
[98] G.M. Curran, et al., Effectiveness-implementation hybrid designs: combining elements of clinical effectiveness and implementation research to enhance public health impact, Med. Care 50 (3) (2012) 217–226.
[99] A. Aguilera, S.M. Schueller, Y. Leykin, Daily mood ratings via text message as a proxy for clinic based depression assessment, J. Affect. Disord. 175 (2015) 471–474.
[100] D.C. Mohr, P. Cuijpers, K. Lehman, Supportive accountability: a model for providing human support to enhance adherence to eHealth interventions, J. Med. Internet Res. 13 (1) (2011) (p. e30).
[101] S.M. Schueller, C. Stiles-Shields, L. Yarosh, Online treatment and virtual therapists in child and adolescent psychiatry, Child Adolesc. Psychiatr. Clin. N. Am. 26 (1) (2017) 1–12.
[102] K. Gibson, C. Cartwright, Young people's experiences of mobile phone text counselling: balancing connection and control, Child Youth Serv. Rev. (43) (2014) 96–104 Supplement C.
[103] T. Hanley, Understanding the online therapeutic alliance through the eyes of adolescent service users, Couns. Psychother. Res. 12 (1) (2012) 35–43.
[104] N. Lublin, Helping texters, saving lives… with big data, White House Commemoration of World Mental Health Day, Partnerships for Suicide Prevention, Washington, DC, 2015.
[105] R.H. Aseltine, et al., Evaluating the SOS suicide prevention program: a replication and extension, BMC Public Health 7 (1) (2007) 161.
[106] W. van Ballegooijen, et al., Adherence to internet-based and face-to-face cognitive behavioural therapy for depression: a meta-analysis, PLoS One 9 (7) (2014) e100674.
[107] L.G. Morrison, et al., What design features are used in effective e-health interventions? A review using techniques from critical interpretive synthesis, Telemed. J. E Health 18 (2) (2012) 137–144.
[108] D.C. Mohr, et al., A randomized controlled trial evaluating a manualized TeleCoaching protocol for improving adherence to a web-based intervention for the treatment of depression, PLoS One 8 (8) (2013) e70086.
[109] K.A. Kobak, J.C. Mundt, B. Kennard, Integrating technology into cognitive behavior therapy for adolescent depression: a pilot study, Ann. General Psychiatry 14 (2015) (p. 37).
[110] L.M. Collins, et al., Factorial experiments: efficient tools for evaluation of intervention components, Am. J. Prev. Med. 47 (4) (2014) 498–504.
[111] L.M. Collins, et al., A strategy for optimizing and evaluating behavioral interventions, Ann. Behav. Med. 30 (1) (2005) 65–73.
[112] L.M. Collins, J.J. Dziak, R. Li, Design of experiments with multiple independent variables: a resource management perspective on complete and reduced factorial designs, Psychol. Methods 14 (3) (2009) 202–224.
[113] C.F.J. Wu, M. Hamada, Experiments: Planning, Design, and Parameter Optimization, Wiley, New York, 2000.
[114] R.E. Glasgow, E. Lichtenstein, A.C. Marcus, Why don't we see more translation of health promotion research to practice? Rethinking the efficacy-to-effectiveness transition, Am. J. Public Health 93 (8) (2003) 1261–1267.
[115] I. Nahum-Shani, et al., Just-in-time adaptive interventions (JITAIs) in mobile health: key components and design principles for Ongoing health behavior support, Ann. Behav. Med. 52 (6) (2018 May 18) 446–462.
[116] J.T. Sherrill, Adaptive treatment strategies in youth mental health: a commentary on advantages, challenges, and potential directions, J. Clin. Child Adolesc. Psychol. 45 (4) (2016) 522–527.
[117] P.A. Harris, et al., Research electronic data capture (REDCap)–a metadata-driven methodology and workflow process for providing translational research informatics support, J. Biomed. Inform. 42 (2) (2009) 377–381.
[118] M.A. Straus, et al., The revised conflict tactics scales (CTS2): development and preliminary psychometric data, J. Fam. Issues 17 (3) (1996) 283–316.
[119] A.K. Allgaier, et al., Screening for depression in adolescents: validity of the patient health questionnaire in pediatric care, Depress Anxiety 29 (10) (2012) 906–913.
[120] K. Kroenke, R.L. Spitzer, J.B. Williams, The PHQ-9: validity of a brief depression severity measure, J. Gen. Intern. Med. 16 (9) (2001) 606–613.
[121] A.S. Moriarty, et al., Screening and case finding for major depressive disorder using the patient health questionnaire (PHQ-9): a meta-analysis, Gen. Hosp. Psychiatry 37 (6) (2015).
[122] R.M. Cunningham, et al., Characteristics of youth seeking emergency care for assault injuries, Pediatrics 133 (1) (2014) e96–105.
[123] M.A. Walton, et al., Effects of a brief intervention for reducing violence and alcohol misuse among adolescents: a randomized controlled trial, JAMA 304 (5) (2010) 527–535.
[124] N.T. Van Dam, M. Earleywine, Validation of the Center for Epidemiologic Studies Depression Scale–Revised (CESD-R): pragmatic depression assessment in the general population, Psychiatry Res. 186 (1) (2011) 128–132.
[125] J.E. Young, A.T. Beck, Cognitive Therapy Scale Rating Manual, Center for Cognitive Therapy, Philadelphia, PA, 1980.
[126] F. Muench, et al., Understanding messaging preferences to inform development of mobile goal-directed behavioral interventions, J. Med. Internet Res. 16 (2) (2014) e14.
[127] L. Yardley, et al., The person-based approach to intervention development: application to digital health-related behavior change interventions, J. Med. Internet Res. 17 (1) (2015) (p. e30).
[128] J. Broderick, et al., Designing Health Literate Apps, Institute of Medicine, 2014.
[129] D.C. Mohr, et al., The behavioral intervention technology model: an integrated conceptual and technological framework for eHealth and mHealth interventions, J. Med. Internet Res. 16 (6) (2014) e146.
[130] D.A. Wolfe, et al., Development and validation of the conflict in adolescent dating relationships inventory, Psychol. Assess. 13 (2) (2001) 277–293.
[131] D.L. Espelage, M.K. Holt, Bullying and victimization during early adolescence, J. Emot. Abus. 2 (2–3) (2001) 123–142.
[132] K.R. Williams, N.G. Guerra, Prevalence and predictors of internet bullying, J. Adolesc. Health 41 (6 Suppl 1) (2007) p. S14–21.
[133] E. Gullone, J. Taffe, The emotion regulation questionnaire for children and adolescents (ERQ-CA): a psychometric evaluation, Psychol. Assess. 24 (2) (2012) 409–417.
[134] P. Muris, A brief questionnaire for measuring self-efficacy in youths, J. Psychopathol. Behav. Assess. 23 (3) (2001) 145–149.
[135] K. Bosworth, D. Espelage, Teen Conflict Survey, Center for Adolescent Studies, Indiana University, Bloomington, IN, 1995.
[136] B.H. Ascher, et al., The child and adolescent services assessment (CASA): description and psychometrics, J. Emot. Behav. Disord. 4 (1) (1996) 12–20.

[137] National Institute of Drug Abuse, NIDA-Modified ASSIST Prescreen V1.0.
[138] A. Prins, et al., The primary care PTSD screen (PC-PTSD): development and operating characteristics, Prim. Care Psychiatry 9 (1) (2003) 9–14.
[139] J. Canty-Mitchell, G.D. Zimet, Psychometric properties of the multidimensional scale of perceived social support in urban adolescents, Am. J. Community Psychol. 28 (3) (2000) 391–400.
[140] G.D. Zimet, et al., The multidimensional scale of perceived social support, J. Pers. Assess. 52 (1) (1988) 30–41.
[141] R.E. Sieving, et al., Development of adolescent self-report measures from the National Longitudinal Study of adolescent health, J. Adolesc. Health 28 (1) (2001) 73–81.
[142] Gender Identity in U.S. Surveillance Group, Gender-Related Measures Overview, The Williams Institute, University of California School of Law, Los Angeles, CA, 2013.
[143] J.J. Dziak, I. Nahum-Shani, L.M. Collins, Multilevel factorial experiments for developing behavioral interventions: power, sample size, and resource considerations, Psychol. Methods 17 (2) (2012) 153–175.
[144] K.J. Preacher, A.F. Hayes, Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models, Behav. Res. Methods 40 (3) (2008) 879–891.
[145] H.C. Kraemer, et al., Caution regarding the use of pilot studies to guide power calculations for study proposals, Arch. Gen. Psychiatry 63 (5) (2006) 484–489.
[146] A.C. Leon, L.L. Davis, H.C. Kraemer, The role and interpretation of pilot studies in clinical research, J. Psychiatr. Res. 45 (5) (2011) 626–629.
[147] S.E. Hetrick, et al., Cognitive behavioural therapy (CBT), third-wave CBT and interpersonal therapy (IPT) based interventions for preventing depression in children and adolescents, Cochrane Database of Systematic Reviews, 2016 (8).
[148] R.J. Little, D.B. Rubin, Statistical Analysis with Missing Data, 2nd edition, Wiley Interscience, Hoboken, NJ, 2002.
[149] K. Nylund, et al., Subtypes, severity, and structural stability of peer victimization: what does latent class analysis say? Child Dev. 78 (6) (2007) 1706–1722.
[150] J.D. Ford, et al., Poly-victimization and risk of posttraumatic, depressive, and substance use disorders and involvement in delinquency in a national sample of adolescents, J. Adolesc. Health 46 (6) (2010) 545–552.
[151] L.K. Whiteside, et al., The overlap of youth violence among aggressive adolescents with past-year alcohol use-a latent class analysis: aggression and victimization in peer and dating violence in an inner city emergency department sample, J. Stud. Alcohol Drugs 74 (1) (2013) 125–135.
[152] A. Spirito, et al., An intervention trial to improve adherence to community treatment by adolescents after a suicide attempt, J. Am. Acad. Child Adolesc. Psychiatry 41 (4) (2002) 435–442.
[153] R.M. Bossarte, T.R. Simon, M.H. Swahn, Clustering of adolescent dating violence, peer violence, and suicidal behavior, J. Interpers Violence 23 (6) (2008) 815–833.
[154] V.A. Foshee, et al., Risk and protective factors distinguishing profiles of adolescent peer and dating violence perpetration, J. Adolesc. Health 48 (4) (2011) 344–350.
[155] S. Malik, S.B. Sorenson, C.S. Aneshensel, Community and dating violence among adolescents: perpetration and victimization, J. Adolesc. Health 21 (5) (1997) 291–302.
[156] Lenhart, A., Teens, Technology, and Friendships. 2015, Pew Research Center.
[157] IMS Institute for Healthcare Informatics, Patient adoption of mhealth: use, evidence, and remaining barriers to mainstream acceptance, (2015) (Parsipanny, NJ).
[158] K. Jones, et al., The impact of health education transmitted via social media or text messaging on adolescent and young adult risky sexual behavior: a systematic review of the literature, Sex. Transm. Dis. 41 (7) (2014) 413–419.
[159] S. Pagoto, et al., Adapting Behavioral interventions for social media delivery, J. Med. Internet Res. 18 (1) (2016) e24.
[160] L.M. Yonker, et al., "Friending" teens: systematic review of social media in adolescent and Young Adult Health Care, J. Med. Internet Res. 17 (1) (2015) e4.
[161] R.M. Cunningham, et al., Alcohol interventions among underage drinkers in the ED: a randomized controlled trial, Pediatrics 136 (4) (2015) (p. e783–93).
[162] L.J. Loescher, et al., A systematic review of interventions to enhance healthy lifestyle Behaviors in adolescents delivered via Mobile phone text messaging, Am. J. Health Promot. 32 (4) (2018 May) 865–879.
[163] A.E. Whitton, et al., Breaking open the black box: isolating the Most potent features of a web and Mobile phone-based intervention for depression, anxiety, and stress, JMIR Ment. Health 2 (1) (2015) e3.
[164] S.D. Kauer, et al., Self-monitoring using mobile phones in the early stages of adolescent depression: randomized controlled trial, J. Med. Internet Res. 14 (3) (2012) e67.
[165] C.M. Kelly, et al., Technology use, preferences, and capacity in injured patients at risk for posttraumatic stress disorder, Psychiatry 80 (3) (2017) 279–285.
[166] D. Zatzick, et al., Technology-enhanced stepped collaborative care targeting posttraumatic stress disorder and comorbidity after injury: a randomized controlled trial, J. Trauma. Stress. 28 (5) (2015) 391–400.
[167] T.D. Koepsell, D.F. Zatzick, F.P. Rivara, Estimating the population impact of preventive interventions from randomized trials, Am. J. Prev. Med. 40 (2) (2011) 191–198.
[168] Office of Behavioral and Social Science Research, Strategic Plan 2017–2021, National Institutes of Health, Bethesda, MD, 2016.
[169] National Institutes of Health, NIH-Wide Strategic Plan: Fiscal Years 2016–2020. Department of Health and Human Services: Bethesda, MD.