Improving Teen Care with HIT

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Abstract

Purpose

To further develop and test the effectiveness of a multi-risk adolescent interactive health assessment (iHA) with integrated feedback and results provision for clinicians in primary care settings.

Scope

Tool revisions were conducted based on adolescent qualitative input and a randomized controlled trial (RCT) of the iHA tool in 5 primary care practices.

Methods

Semi-structured interviews regarding the iHA were conducted with 31 adolescents and analyzed. The iHA was updated based on results. The revised IHA was subsequently tested in an RCT among 300 teens (13-18 years) seeking well-care in 5 pediatric practices. Intervention adolescents (n=145) received the full iHA tool (electronic screening, feedback, and report of results for the clinician). Control adolescents (n=155) received usual care. Outcomes included counseling during the well-visit (primary), patient satisfaction (primary), and risk behavior change at 3- (primary) and 6-months (secondary).

Results

After adjusting for age, gender, and clinic, intervention adolescents were 36% more likely than control to have received counseling for endorsed behaviors (aRR-1.36, 95% CI: 1.04, 1.78). Both intervention and control adolescents reported decreased risk behaviors at 3- and 6-month follow-up with no significant differences between groups (3-month group difference: β=-0.15, 95% CI: -0.57, -0.01, P=.05; 6-month group difference: β=-0.12, 95% CI: -0.29, 0.52, P=.57). Patient satisfaction did not significantly differ between groups.

Conclusions

The iHA improved the delivery of clinician counseling but health risk behavior change was not significantly different between groups. More research is needed to identify effective strategies to reduce risk in well care.

Key Words**:** Adolescents, Primary Care, Preventive Health, Health Risk Behaviors

Purpose

This project further developed and tested iHA technology for implementation in primary care settings prior to a healthcare visit. The iHA was designed to: 1) conduct multi-risk screening; 2) provide personalized youth-directed prevention and risk reduction feedback; and 3) summarize youth-reported risk behaviors, goals, and consequences for clinicians in order to stimulate patient-clinician discussions. Areas covered include substance use; activity and sleep; diet behavior; sexual health; emotions; and safety.

The Phase 1 qualitative study was conducted to inform the following aims:

Aim 1. To optimize the iHA design and content for adolescents and clinicians

Aim 2. To develop implementation processes and training materials to facilitate the use of iHA

Phase 2 evaluated the following aims in a randomized control trial (RCT):

Aim 3. To examine the impact of iHA on clinician counseling and patient satisfaction

Aim 4. To examine the efficacy of iHA in reducing adolescent health risk behaviors

Scope

Background

Many of the causes of adolescent and adult morbidity and mortality result from participation in health risk behaviors (alcohol and other drug use, smoking, sexual activity without use of protection, inadequate sleep, unsafe driving or biking, unhealthy eating patterns, depression, and physical inactivity) that begin during adolescence and persist into adulthood.[1, 2] In recognition of the impact of these behaviors, Healthy People 2020 delineates critical health objectives that address each of these areas[3] and professional practice guidelines from multiple organizations recommend screening and counseling during adolescence to prevent and reduce these health risk behaviors.[4, 5]

Adolescents list clinicians among the first people with whom they would consider discussing risk behaviors, and report that they are more satisfied with care when clinicians discuss these sensitive topics with them than when they do not.[6, 7] In primary care, many studies have documented the lack of screening and counseling by clinicians.[8-11]Additionally, studies suggest that electronic screening tools,[12-14] clinician training[15, 16] and providing information about patient motivation and goals[13] increases the delivery of counseling, with greater increases seen in trials that incorporated implementation of both screeners and clinician training.[15, 16] For example, in one study, providing clinicians with in-person training and an adolescent screening form with systems support for implementation increased the rate of preventive counseling for targeted behaviors from 54% to 82%.[15] Results of another study indicated that electronic screening has advantages over other formats. Specifically, 90% of adolescents indicated that they were comfortable answering health behavior questions using electronic screening, compared to 77% for a clinician interview and 57% for paper screening.[17] Additionally, 89% of adolescents indicated that they were more likely to be honest in answering health behavior questions using electronic screening versus 74% for clinician interview and 61% for paper screening.[17]

We previously developed a tablet-based interactive Health Assessment (iHA) addressing key barriers to the delivery of targeted intervention following screening of adolescents in primary care. This project further developed and tested this iHA technology for implementation in primary care settings prior to a healthcare visit. The iHA is designed to: 1) conduct multi-risk screening; 2) provide personalized youth-directed prevention and risk reduction feedback; and 3) summarize youth-reported risk behaviors, goals, and consequences for Primary Care Providers (PCPs) in order to stimulate patient-provider discussions around prevention and risk reduction. Areas covered by the iHA include substance use; activity and sleep; unhealthy eating; sexual health; emotions; and safety. The iHA feedback aimed to provide education regarding health risks and consequences, and contextualizing youth reported risk behaviors related to peer norms or guideline recommendations. The iHA offered tips for engaging in behavior change as well as opportunities for goal setting around specific behaviors. Youth were encouraged to talk with the clinician about their results as well as provided with the opportunity to receive more information online following the visit. Clinicians received the results of the iHA to increase knowledge and awareness of adolescent-reported risks and goals.

This study involved two components. Phase 1 included qualitative interviews aimed at assessing youth preferences regarding electronic screening and feedback as well as preferences and practices regarding youth use of technology for health. This information was then used to inform work to redesign and update the iHA to better address youth preferences. The updated version of the iHA was subsequently tested compared to usual care in the Phase 2 randomized controlled trial.

Phase 1: Qualitative Study Methods

Study Design

We conducted individual semi-structured interviews with adolescents recruited from the waiting room of the Seattle Children's Hospital Adolescent Clinic, via flyers in the Seattle Children's Sports Medicine Clinic waiting room, and by invitation among youth who applied to participate in a teen health advisory board but were not accepted. Eligibility included being between the ages of 13-18 years. Purposive sampling methods were used to assure inclusion of teens of diverse age, race, and ethnicity.

Once an eligible adolescent indicated interest in participating in the study, a research team member reviewed the study content and procedures with them. Written parent/guardian consent and youth assent was obtained for youth under age 18. Eighteen-year-olds provided their own written consent. Interviews were conducted in a private room in the adolescent clinic or a library or by phone, when needed. All interviews were conducted one-on-one by a trained interviewer and lasted about 45-60 minutes. Adolescent participants received a $30 gift card for participating. Prior to conducting interviews, adolescent participants completed the iHA either on a tablet or online.

The interview team reviewed transcripts following each interview and additional subjects were recruited until concept saturation was reached, with no new themes being identified as defined by Kerr and colleagues.[18] Analysis was conducted by a team of researchers using thematic analysis methods with differences in themes resolved via discussion. Results of this analysis were used to inform development of the adapted version of the iHA tool.

Data Sources/Collection

Prior to starting interviews, interview guides were developed by the principal investigators and the interview team. The interview guides were adapted over the course of the study by removing questions after interval analysis of the data indicated that we had reached theoretical saturation (a point at which no new themes were being uncovered in interviews) and adding new prompts to further explore emerging concepts. All interviews were audio-recorded and transcribed. Interviewers reviewed each transcript independently for accuracy and as a group for content and theoretical saturation.

Data Analysis

There were four coders as part of the qualitative analytic team. Prior to beginning any coding, the team and principal investigators generated a codebook based on the topics covered in the interview and the theoretical model underlying the development of the iHA. The codes from the first three interviews were reconciled as an entire team to ensure interpretation of the codebook was uniform. Thereafter, each interview was coded by two independent coders, with differences in codes reconciled via discussion. Inter-rater reliability was not assessed during the process, instead the coding team benefited from the discussions of reconciling codes as a way of aligning their interpretations of codes. Throughout the data collection and analysis process, themes in the data were identified through groups of codes and reviewed as a team to inform subsequent interviews and potential new codes. Once coding was complete, themes and sub-codes were reviewed and refined by the team and the principal investigators to accurately reflect all data collected.

Limitations

This project included a small sample of adolescents and may not be generalizable to all adolescents. Additionally, while we tried to assure involvement from participants of different genders, ages, and racial and ethnic background, the overall sample size was too small to separately evaluate the effect of adolescent age, gender and cultural background.

Phase 1: Qualitative Study Results

Principal Findings and Outcomes

We conducted interviews with 31 adolescents. The average age of participants was 15 years (SD=1.4). Fifty-eight percent identified as female and 42% identified as male. Nineteen percent of participants were of Hispanic ethnicity. Sixty-five percent identified as White, 10% Asian, 7% African American, 7% Multiracial and 13% preferred not to specify a race.

Overall, the iHA was positively-received by youth participants who saw it as a way to enhance—but not replace—their interactions with clinicians. They appreciated the non-judgmental feedback from the iHA and responded well to information regarding the consequences of behaviors, comparisons to peer norms and health guidelines, tips for behavior change, and reinforcement of healthy choices. When prompted for possible adaptations to the tool, adolescents expressed interest in more interactive elements and reduced text as well as receiving follow-up information and setting health-related goals. Youth also identified several electronic tools that they use for health and were interested in learning more about tools to track their behaviors over time as well as to communicate with providers electronically between appointments.

Discussion and Conclusions

The results of the qualitative interviews were detailed in two manuscripts that have been published in peer reviewed journals as described in the publication section. Our first publication[19] detailed the adolescents' perspectives on the iHA tool including detailing adolescent preferences for electronic screening over paper-and-pencil forms as they were perceived to be more interactive, visually interesting and private.. We also found that teens reported that they would be more likely to disclose more health risk behaviors to the tool than to paper-and-pencil forms, consistent with prior research.[20-25] Additionally, consistent with prior research on electronic screening, participants perceived the iHA as a way to enhance—but not replace—interactions with clinicians by helping them to identify questions and concerns before an appointment.[25, 26] The second publication detailed the types of online resources adolescents reported using to learn about health and health behavior change[27] with many teens reporting that they used electronic tools to learn about their health and monitor their behaviors.

The results of these qualitative interviews were subsequently used to inform further user-centered design work to adapt the tool to align with features that the teens found most appealing including the addition of more interactive elements, decreasing text components, adding components on setting health-related goals and providing opportunities for youth to receive additional electronic resources following the appointment.

Phase 2: RCT Study Methods

Study Design

This phase of the study was conducted at five Puget Sound Pediatric Research Network (PSPRN) Clinics located in Western Washington. PSPRN is a practice-based research network that comprises over 45 clinicians from 8 pediatric clinics who have participated in multiple large pediatric primary care studies. All PSPRN clinics were eligible to participate in the current study if they were willing to participate in study activities, with no exclusion criteria. Participating clinics included: Skagit Pediatrics, Odessa Brown Children's Clinic, Woodinville Pediatrics, Yakima Pediatrics and Ballard Pediatrics. These clinics overall represented a wide cross-section of adolescent patients and their caregivers, including

adolescents of racial/ethnic minority status and families across a range of income levels in both urban and small-town settings.

We obtained a waiver to receive contact information for adolescents who had an upcoming scheduled well visit. Adolescents ages 13-18 who had a scheduled well child visit at a participating clinic with a participating provider were invited to the study. Adolescents were excluded from the study if they (or a sibling) had participated in a prior study using the iHA tool. They were also excluded if a sibling was already participating in the current study or if they could not read/speak English.

Clinic staff identified all patients (ages 13-18) with upcoming well child visits and sent our team a referral list with the patient names and contact information. Our study team then sent English, Spanish, and Somali versions of study invitation letters, flyers and consent forms to potential participants Our study team subsequently followed up with caregivers and adolescents by phone to further explain the study, assess interest and schedule a baseline evaluation. Adolescent assent and caregiver consent were obtained prior to starting the study. Participants over the age of 18 were consented directly and did not require parental consent. If participants declined the study in the initial phone screening, Research assistants asked if they would be willing to give a reason for not participating. These answers were recorded and tracked.

Data Sources/Collection

Survey data was collected at baseline, and 1 day, 3 months and 6 months post well-visit. The baseline survey was completed as part of the iHA with feedback for intervention participants and as the iHA screening component only for the usual care control participants. All follow-up surveys were conducted online via an electronic survey invitation sent via text or email, depending on the preferences of the participant. Adolescent participants could complete surveys using a computer, cell phone or tablet. They were instructed to complete online surveys privately and independently. Study staff called to remind participants who did not complete the survey after receiving the electronic invitation and electronic reminders.

Interventions

Intervention adolescents were given the full iHA including electronic screening, personalized feedback, and a report of results for their clinician prior to their appointment. Control adolescents completed the iHA screening questions at baseline for assessment purposes only. They did not receive iHA personalized feedback about their health behaviors and their clinicians did not receive any information of reported youth behaviors on the screener. As clinicians would not know prior to the visit, if a youth had been randomized to the intervention, they were instructed to continue to use any screening tools that they were using for all patients regardless of study arm. Clinicians could provide any counseling or treatment recommendations during the visit that they would normally make.

Measures

At baseline, youth completed the health risk screener component of the iHA either with feedback (intervention youth) or alone (usual care control youth). To minimize missing data, the baseline survey was programmed to require a response before proceeding to the next item. Follow-up surveys were conducted online at three time points: 1-day and 3- and 6-months after their well-child visit. For the follow-up surveys, adolescents were allowed to skip questions. The 1-day follow-up survey assessed the content of the visit including delivery of counseling to change behavior for each screened behavior. Items assessing the visit were adapted from the Adolescent Report of the Visit developed by Ozer and colleagues.[16] The 3-month and 6-month follow-up surveys assessed the same health risk behaviors as at baseline collected via an online survey tool, REDCap.[28] Participants were asked about suicidality at baseline and all follow-up timepoints. To ensure their safety, study investigators, who are

also clinicians, followed up with all participants in either study arm who reported having thoughts of harming themselves in the past 2 weeks and thoughts of killing themselves or prior suicide attempt in the past 3 months and assisted them in accessing clinical services.

Data Analysis

All data analyses were conducted using R 3.5.0[29] using an intent-to-treat framework. We first conducted bivariate analyses to evaluate differences between control and intervention adolescents in demographics and baseline risk. Subsequently, we conducted our main analyses on the three primary outcome measures: clinician counseling during the visit, a summary score of health risk behaviors measured at 3 months post visit, and patient satisfaction. Our secondary outcome measure, the health risk behaviors summary score at 6-months, was analyzed together with the 3-months summary score using repeated measures analysis.

Based on the design of the study, missing data only occurred during outcome assessments. We compared baseline characteristics of participants with and without missing outcomes and found no differences between groups. We further conducted sensitivity analyses for each of our primary outcomes using multiple imputation with chained equations (MICE) methods using linear regression and predictive mean matching for continuous outcomes. For categorical outcomes, we applied classification and regression tree methods for imputation using MICE methods. Estimates from the fitted models on multiple imputed datasets were pooled to generate the results for inference. In conducting these sensitivity analyses, we found that results were almost identical for imputed and complete case analysis. Thus, only complete case analysis results are presented in this report.

Clinician Counseling Outcome: Clinician counseling during the visit, measured on the 1-day assessment, was defined as adolescent-report of the clinician having counseled them to change an endorsed behavior towards health. This measure was constructed by summing all endorsed moderate- and high-risk behaviors for which adolescents reported receiving counseling. We conducted an adjusted analysis using a mixed effects Poisson regression model in which the dependent variable was the counseling measure and treatment group was the predictor of interest. Baseline age and sex were included as covariates, and a clinic-specific random effect was included to account for clustering within clinic. The total number of endorsed moderate- and high-risk behaviors was entered as an offset to ensure regression coefficients had proper rate interpretation. As an exploratory sub-analysis to evaluate if higher risk behaviors were more likely to receive counseling than moderate risk behaviors, we also conducted two additional regression analyses focused specifically on counseling for each category of risk behaviors: high risk and moderate risk, controlling for the same variables as the main analysis.

Risk Behavior Outcome: The risk behavior outcome analyses employed a summary score of all assessed behaviors at 3-months (primary outcome) and 6-months (secondary outcome) post visit. The risk behavior scores were constructed for each participant by adding all of the risk behaviors for which the tool included feedback (alcohol use, marijuana or other drug use, driving while intoxicated, tobacco use, depression, texting while driving, inconsistent seatbelt use, inconsistent helmet use, unprotected sexual activity, high sugary beverage intake, low fruit and vegetable intake, inadequate sleep, and low physical activity) at 3- and 6-months. High risk behaviors were assigned a score of 2, moderate-risk a score of 1, and low-risk a score of 0 (score potential range: 0 to 21, further details regarding items in Table 1). Treating baseline, 3-month, and 6-month risk scores as repeated measures, we applied linear mixed effects regression models to compare changes over time in adolescent-reported total risk score at 3- and 6-months, relative to baseline, in intervention versus control adolescents controlling for baseline sex, age, and clinic as a random effect. To examine effects of the intervention on health risk behaviors, we also conducted exploratory logistic regression analyses for individual risk behaviors. Due to concerns

about estimate instability, we did not conduct analyses for individual behaviors in which fewer than 10 adolescents per study arm endorsed the behavior.

Patient Satisfaction Outcome: Patient satisfaction was measured on the 1-day post-visit survey using a satisfaction scale ranging from 1-10 from the Consumer Assessment of Healthcare Providers and Services.[30] This outcome was examined using linear mixed effect regression while controlling for baseline age and sex, and clinic-specific random effect.

Control adolescents were the reference group for all regression analyses. For mixed effects Poisson regression, we determined an estimate was statistically significant if its 95% confidence interval for the rate ratio did not include 1. For the mixed effects linear regression models, statistical significance was based on p-values calculated via Satterwaite's degrees of freedom method.[30]

Table 1. Items Included in Risk Behavior Score

	Low (0)	Moderate (1)	High (2)
Nutrition			
Servings of Fruits/ Vegetables per day	4+	0-3	
Sugared drinks per day	0-1	2+	
Activity			
Sleep hours/night	8+	0-7	
Days/week physically active at least 60 mins	4+	0-3	
Safety			
Seat Belt Use	Always		Any other answer
Bike Helmet Use	Always		Any other answer
Drives drunk or high	No		Yes
Texts while driving	No		Yes
Drugs and Alcohol			
Alcohol	Low risk for both quantity and frequency (depending on age and gender)	Moderate risk for frequency and low risk for quantity (depending on age and gender)	High risk on either frequency or quantity (depending on age and gender)
Marijuana/Other Substance Use	None	Marijuana frequency (depending on age)	Other Drugs (any use); Marijuana frequency (depending on age)
Tobacco	None	Any use	
Sexual Activity			
Risky Sexual Behavior	Not sexually active OR Used birth control at last sex AND Always uses condom with sex		Sexually active AND No birth control with last sex OR Does not always use condom with sex
Depression			
PHQ-9 Score	<10		10 or more

Limitations

There are several limitations to the current study. First, while the use of a combined risk-behavior outcome measure allowed us to test across the full range of behaviors for which clinicians were providing counseling, it is more difficult to interpret and limits our ability to draw conclusions on individual behaviors. We selected this measure as we feel it is more consistent with the multi-risk focus of behavioral counseling delivered in the pediatric well-care visit setting. However, this approach limits the conclusions we can draw with regards to changes in any specific behavior. We conducted secondary analyses of individual behaviors to allow for more ready interpretation of the intervention; however, for many behaviors the prevalence at baseline was too low to draw conclusions on behavior change. The use of this multi-risk measure also limits our ability to compare outcomes with other studies, as prior research has measured a range of individual behavior outcomes.[31]

A second limitation in this study was the low prevalence of individual behaviors. Consistent with other studies in pediatric primary care[32, 33], including our own[14], adolescents receiving well- care tended to be younger: 76% (N=228) of participants were in the 13-15 year-old age group. Younger adolescents are less likely to engage in risk behaviors than older adolescents, which may limit the ability to show change in behaviors. It is also possible that adolescents are less likely to endorse risk in the setting of a well-child visit due to concerns about confidentiality. Finally, this study was conducted among adolescents seen for a well-care visit in primary care clinics in the Pacific Northwest and may not be generalizable to other settings.

Phase 2: RCT Study Results

Principal Findings and Outcomes

In total, letters were sent to 1665 homes inviting adolescents to participate (see Consort Diagram, Figure 1). The final study sample that completed all consent and baseline procedures was 301 adolescents (23% of eligible sample). One adolescent withdrew from the study and requested that their data not be used, leaving an analytic sample of 300 adolescents. After consent, 145 were randomized to the intervention and 155 to the control group. The response rates at 1-day, 3-months, and 6-months were 94% (N=282), 94% (N=283), and 95% (N=284), respectively.

Baseline Demographics and Risk Assessment: Randomization was balanced with no differences between intervention and control adolescents in demographics or baseline risk score (Table 2). In the full sample (N=300), 43% (n=129) of participants were female, 76% (n=228) were between the ages of 13-15 and 24% (n=72) were ages 16-18. Most adolescents identified as white/caucasian (64%; n=192) with the next largest group identifying as being of more than one race or "other" (18%; n=55). Ninety-two percent of adolescents had at least one health risk behavior at baseline with the mean baseline risk score of 2.86 (SD 2.33) for intervention and 3.10 (SD 2.52) for control participants. Table 3 summarizes the reported risk behaviors in order of baseline frequency at baseline, 3 and 6 months with the most common risk behavior being low fruit and vegetable intake and the least frequent being driving under the influence.

Table 2. Demographics of Randomized Controlled Trial Sample

Characteristic		**Control (N=155)**	**Intervention (N=145)**
Gender n (%)	Female	70 (45%)	59 (41%)
	Male	82 (53%)	86 (59%)
	Trans or Non-binary	3 (2%)	0 (0%)
Age n (%)	13 – 15 yrs	114 (74%)	114 (79%)
	16 – 18 yrs	41 (26%)	31 (21%)
Race/Ethnicity n (%)	Caucasian	99 (64%)	93 (64%)
	Hispanic	12 (8%)	7 (5%)
	African American	13 (8%)	6 (4%)
	Asian/Pacific Islander	7 (5%)	7 (5%)
	Native American	0 (0%)	1 (1%)
	Other/More Than One	24 (16%)	31 (21%)
Risk Behavior Score at Baseline Mean (SD)		3.10 (2.52)	2.86 (2.33)
Characteristic		**Control (N=155)**	**Intervention (N=145)**
Gender n (%)	Female	70 (45%)	59 (41%)
	Male	82 (53%)	86 (59%)
	Trans or Non-binary	3 (2%)	0 (0%)
Age n (%)	13 – 15 yrs	114 (74%)	114 (79%)
	16 – 18 yrs	41 (26%)	31 (21%)

Figure 1. Consort Diagram

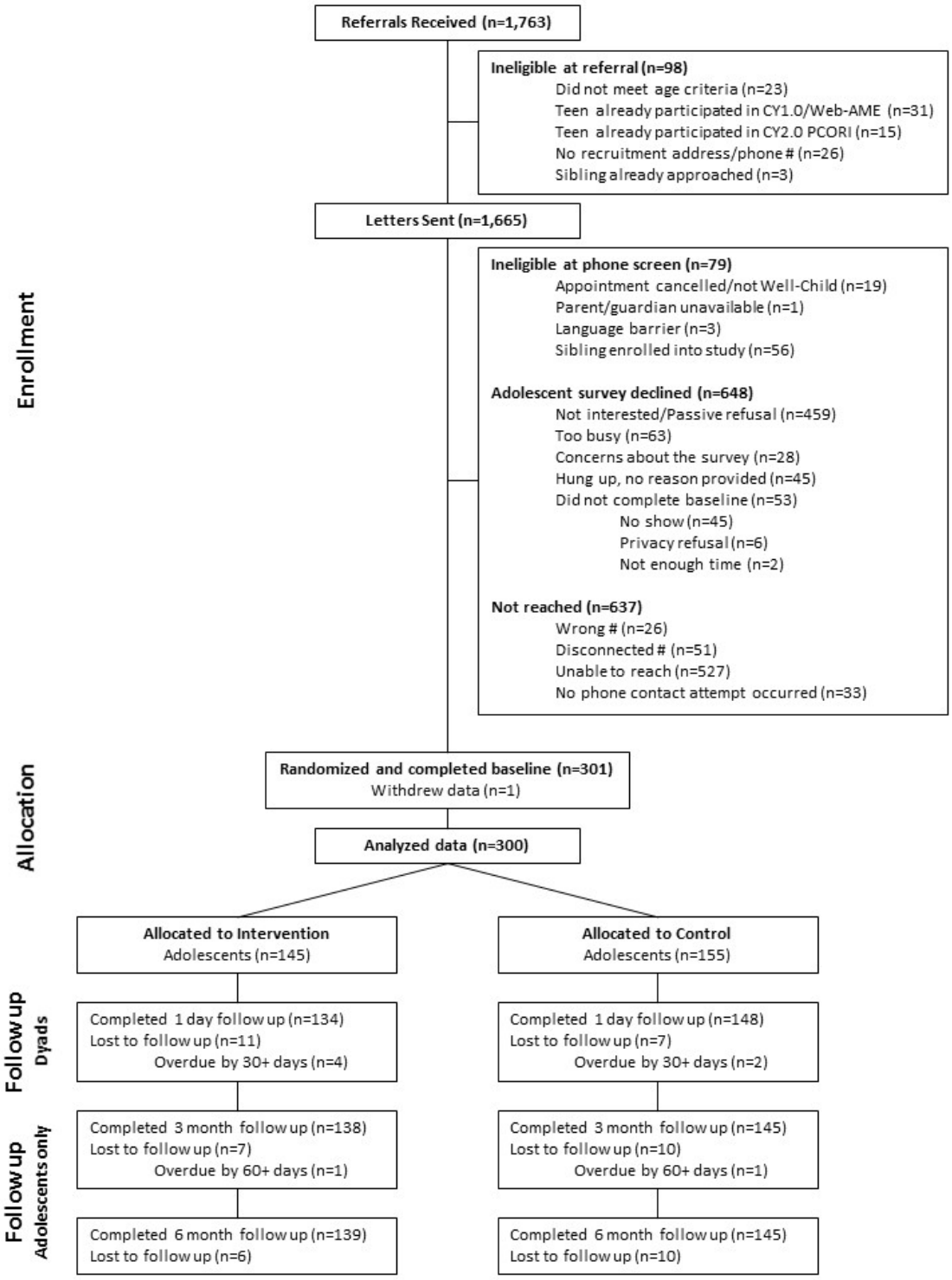
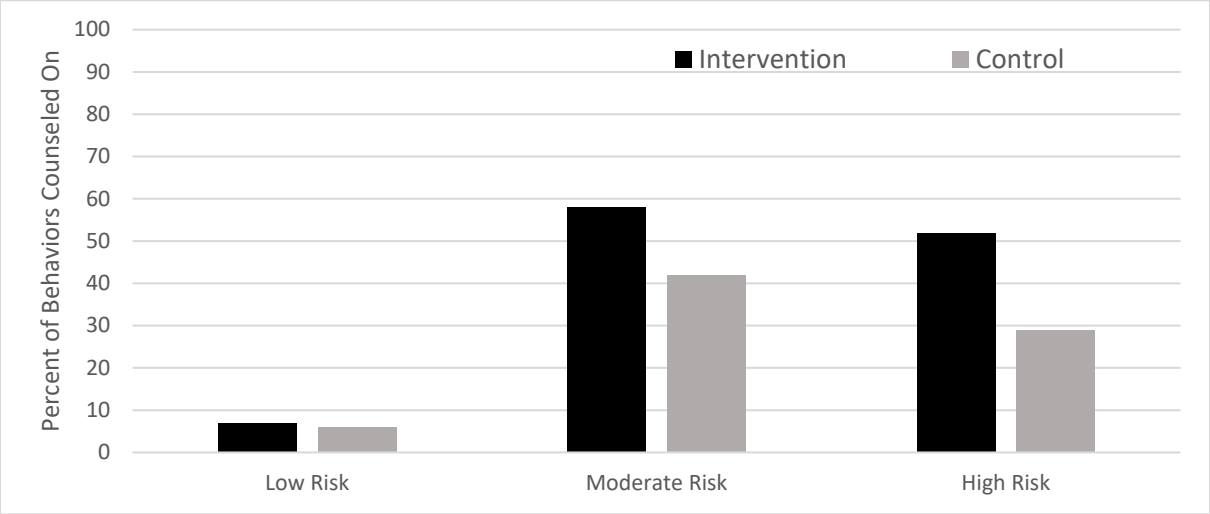


Table 3. Prevalence of individual risk behaviors over time in intervention and control adolescents

** P values were based on likelihood ratio test comparing mixed effects logistic regression with and without period-by-group interaction. Both models controlled for random effects corresponding to within individual clustering.*

Behavior	Intervention			Control			Logistic Regression* *P* value
	Baseline (N=145)	3 months (N=138)	6 months (N=139)	Baseline (N=155)	3 months (N=145)	6 months (N=145)	
Low Fruit/Vegetable Intake	115 (79%)	106 (77%)	98 (70%)	132 (85%)	118 (81%)	111 (77%)	.93
Low Sleep Time	46 (32%)	52 (38%)	65 (47%)	54 (35%)	55 (38%)	72 (50%)	.89
Low Physical Activity	39 (27%)	44 (32%)	36 (26%)	50 (32%)	52 (36%)	51 (35%)	.77
Inconsistent Helmet Use	37 (26%)	24 (17%)	22 (16%)	39 (25%)	25 (17%)	20 (14%)	.54
High Sugary Beverage Intake	28 (19%)	39 (28%)	36 (26%)	36 (23%)	37 (26%)	35 (24%)	.47
Depression	13 (9%)	15 (11%)	14 (10%)	23 (15%)	15 (10%)	18 (12%)	.24
Inconsistent Seatbelt Use	16 (11%)	7 (5%)	11 (8%)	10 (7%)	7 (5%)	10 (7%)	.11
Texting While Driving	9 (6%)	10 (7%)	8 (6%)	13 (8%)	8 (5%)	10 (7%)	NC
Marijuana Use	10 (7%)	4 (3%)	3 (3%)	7 (5%)	4 (3%)	5 (3%)	NC
Alcohol Use	8 (6%)	3 (2%)	4 (3%)	6 (4%)	4 (3%)	4 (3%)	NC
Tobacco Use	4 (3%)	0 (0%)	1 (1%)	4 (3%)	2 (1%)	3 (2%)	NC
Sexual Risk	1 (1%)	3 (2%)	3 (2%)	4 (3%)	2 (1%)	3 (2%)	NC
Driving Under the Influence	0 (0%)	0 (0%)	0 (0%)	2 (1%)	1 (1%)	0 (0%)	NC

Figure 2. Rates of Counseling for Low-, Moderate- and High-Risk Behaviors for Intervention and Control Adolescents

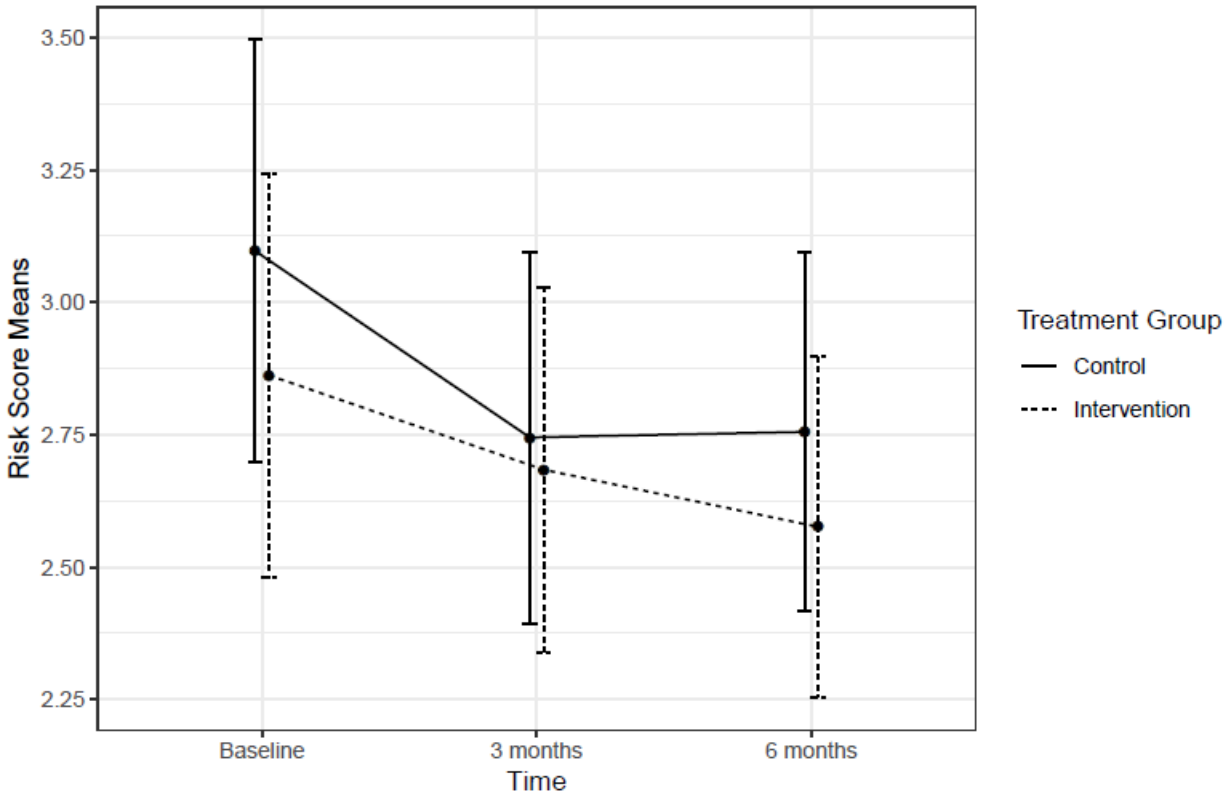


Clinician Counseling Analysis Results: Among control adolescents, 380 moderate and high-risk behaviors were endorsed, among which adolescents reported receiving clinician counseling for 148 (39%) behaviors during the visit. Intervention adolescents reported a total of 326 moderate- and high-risk behaviors among which 184 (56%) were counseled on by clinicians during the visits (Figure 2). In Poisson regression analyses, intervention adolescents were significantly more likely to report that they had received counseling for a combined measure of endorsed moderate- and high-risk behaviors than control adolescents (adjusted rate ratio (aRR): 1.36; 95% CI: 1.04, 1.78). When examining low, moderate and high-risk behaviors separately (Figure 2), intervention adolescents were 40% more likely than adolescents in the control to have received counseling for moderate-risk behaviors (aRR: 1.40; 95% CI: 1.09, 1.80). For high-risk behaviors, the rate of counseling was 70% higher among intervention than control adolescents (aRR: 1.70; 95% CI: 1.06, 2.74). There were no significant differences between intervention and control adolescents in reported counseling for no/low-risk behaviors (aRR: 1.12; 95% CI: 0.85, 1.48).

Risk Behavior and Patient Satisfaction Analyses Results: The baseline risk score was 2.86 (SD2.33) for intervention adolescents and 3.10 (SD2.52) for control adolescents (P = .40). At 3 months, the risk score for intervention adolescents was 2.68 (SD2.04) compared to 2.74 (SD2.11) for control adolescents (P = .81). At 6 months, the risk score for intervention adolescents was 2.58 (SD1.87) compared to 2.76 (SD2.05) for control adolescents (P = .45). In mixed effects linear regression analysis including both 3- and 6-month outcomes, there was a significant reduction in risk behaviors in both groups at 3 months (β= -0.33; 95% CI: -0.62, -0.05; P = .02) and 6 months (β= -0.29, 95% CI: -0.57, -0.01; P=.05). There were no significant differences in risk scores between intervention and control adolescents at either time point (Figure 3). At 3-months the score difference between groups was 0.15 (β=-0.15; 95% CI: -0.25, 0.55; P = .47) and at 6-months it was 0.12 (β=-0.12; 95% CI:-0.29, 0.52; P = .57). In secondary analyses examining individual behaviors, no significant differences in reductions of behaviors were observed between intervention and control adolescents (Table 3). There were also no significant differences between groups in patient satisfaction with the well-care visit process based on regression analysis controlling for age, gender and clinic as a random effect (Intervention mean: 9.46, Control mean: 9.27; P=.07).

Figure 3. Health Risk Behavior Scores in Intervention and Control Adolescents by Time

** Point estimates and 95% confidence intervals of health risk behavior scores at each assessment timepoint in control and intervention adolescents*



Discussion and Conclusions

In this study we found that intervention adolescents were significantly more likely to report having been counseled by clinicians on risk behaviors than control adolescents. However, this did not correspond to differences in the reductions in health risk behaviors. Both groups demonstrated reductions in risk behavior scores with no significant differences between the groups at 3- or 6-months post intervention. There were also no significant differences in satisfaction between the two groups. These results contrast with research on a prior version of this tool[14] which showed both an increase in reported counseling and a reduction in risk behavior scores at 3 months for intervention youth as compared to controls. The current study further adds to the growing body of literature on multi-behavior screening and preventive counseling interventions in adolescent well-care visits which has shown that provider counseling can be increased but the effects on risk behavior reductions tend to be modest and not consistent across studies.[31]

As this was a modified version of our prior tool, it is possible that the new adaptations to increase interactivity resulted in less content exposure, particularly among adolescents who did not feel their behaviors needed to be changed While overall time spent in this version of the tool was longer than the prior tool version, we are unable to assess how long participants spent on specific content or

screens. Future studies should focus on better understanding how risk level influences engagement in interactive feedback content.

In our study, both the intervention and control group had reduced risk levels at 3 months. The reduction in risk for the control group would also have lessened our statistical power to detect differences between groups. It is important to note that all control teens did complete an electronic health risk behavior assessment as part of baseline study procedures. Although clinicians were not provided the results of this screening for control teens, it is possible that completing the electronic screening resulted in behavior change as teens reflected on their responses to risk behavior questions. Additionally, as participants were randomized at the individual level, it is possible that some degree of the improvement in the control teens was due to spillover effects from study clinicians and clinic staff who applied experiences in caring for intervention adolescents to adolescents in the control group. We did not have data regarding the quality or nature of counseling provided in order to test this possibility.

While risk scores continued to trend downward for the intervention sample at 6 months, differences between control and intervention groups were not significant at 6 months. Two prior studies found that significant differences in risk behaviors noted at 3 months were no longer significant at longer-term follow up (12 months).[34, 35] These two studies employed different models of brief intervention than our current study with one focusing on motivational interviewing training and system supports for implementation of a screening tool,[34] and second involving a 20 minute health consultation on youth-selected risk behaviors with a trained nurse.[35] Other studies that have examined 6 or 12 month follow up data have found significant improvements in helmet use[36, 37] and exercise[38] but not other outcomes. Given the healthcare resources directed at screening and preventive counseling, understanding the long-term impacts of multiple risk behavior interventions is an area worthy of future study.

Significance and Implications

Despite its limitations, this study adds to the literature regarding the use of e-Health tools in conducting screening and preventive care for adolescents and raises important questions worthy of further study. Health risk behaviors have a significant influence on morbidity and mortality during adolescence. Electronic screening has been repeatedly shown to increase provider identification of risk. This study further demonstrates that the addition of feedback for the adolescent and results for the clinician increases clinician counseling. Electronic platforms offer tremendous opportunities for developing and testing interventions that can further explore which types of supports and feedback most change behavior in order to demonstrate sustainable reductions in risk.

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List of Publications and Products

Publications

Richardson LP, Parker EO, Zhou CZ, Kientz JA, Ozer E, McCarty CA. Electronic Health Risk Behavior Screening with Integrated Feedback Among Adolescents in Primary Care: A Randomized Control Trial. 2020. Currently revising for the *Journal of Medical Internet Research*.

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Posters

Lind C, Richardson LP, McCarty CA, Stepanchak M, Katzman K. Does electronic health screening with feedback impact adolescents' health beliefs and clinician interactions? Poster presented at: The Society for Adolescent Health and Medicine. 2020 Mar; San Diego, CA.

Barre-Hemingway M, Parker EO, Fandel D, Arghira A, Richardson LP, McCarty CA. *Teen Interest in Electronic Health Tips and Clinical Engagement in Primary Care.* Poster presented at: The Society for Adolescent Health and Medicine. 2019 Mar; Washington, DC.

Al Shimari F, Parker EO, McCarty CA, O'Connor M, Richardson LP. *Factors Associated with Teens Having Time Alone with their Primary Care Providers.* Poster presented at: The Society for Adolescent Health and Medicine. 2019 Mar; Washington, DC.

Parker EO, McCarty CA, Richardson LP. *Co-Occurrence of Heath Risk Behaviors in Adolescents.* Poster presented at: The Society for Adolescent Health and Medicine. 2019 Mar; Washington, DC.

Pham DQ, McCarty CA, Richardson LP. *Investigating the Association between Patient Gender and Rate of Provider Discussion of High-Risk Behaviors in Adolescents.* Poster presented at: The Society for Adolescent Health and Medicine. 2019 Mar; Washington, DC.

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Products

Check Yourself Interactive Health App

The tablet-based Interactive Health Assessment ("Check Yourself") has been designed to: 1) conduct multi-risk screening; 2) provide personalized youth-focused prevention and risk reduction feedback; and 3) summarize results, in addition to youth reported risk behaviors, goals, and consequences for Primary Care Providers (PCPs) in order to stimulate patient-provider discussions. Since the grant started, we refined the app using user-centered design and qualitative input, including developing new feedback screens (part 2 of above) for youth on their sexual health, substance use, and safety, and offering an option for youth to receive electronic health resources by email.