

Use of Inexpensive Technology to Enhance Adolescent Health Screening and Counseling

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Objectives: To describe the health issues reported using a personal digital assistant (PDA) to conduct screening at adolescent well visits, and to determine the effect of a PDA screening tool on the content and quality of the clinical interaction.

Design: The PDA screening tool was used to record adolescent health risk behaviors, and cross-sectional exit surveys were administered before and after PDA introduction.

Setting: Five primary care practices in New England.

Participants: The PDA screening was completed by 1052 youth aged 11 to 19 years. In addition, youth seen before (n=65) and after (n=98) PDA screening implementation completed exit surveys.

Intervention: Adolescents completed the PDA screening immediately before the well visit. Branching questions explored risk behaviors in more depth, including motivation to change. Physicians viewed the summarized findings before the adolescent health visit.

Main Outcome Measures: Health risk behaviors based on PDA data. Exit surveys assessed the quality of the visit and of any discussion of nutrition, exercise, screen time, tobacco use, alcohol and other drug use, and mood.

Results: Multiple risk behaviors (n=3-9) were reported by 30% of 11- to 14-year-olds and 45% of 15- to 19-year-olds. Exit surveys showed that, with PDA use, the proportion of visits that included discussions of health risk behaviors increased for fruit/vegetable intake (60.4% vs 41.7% without PDA use; $P=.03$), tobacco use (54.9% vs 40.0%; $P=.07$), and alcohol use (53.9% vs 38.0%; $P=.05$). With PDA use, more adolescents rated the visit as confidential (83.7% vs 61.5%; $P=.002$), more thought they were listened to carefully (87.8% vs 64.6%; $P<.001$), and more were very satisfied (87.8% vs 63.1%; $P<.001$).

Conclusion: Use of a PDA-based screening tool enhances physician counseling and improves adolescents' perceptions of the well visit.

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ADOLESCENCE IS A TIME OF rapid and complex change when health risks occur mainly because of behavioral rather than biomedical issues. Adolescents face important behavioral choices with immediate and long-term health consequences. Although many typical adolescent behaviors are experimental, habits and coping patterns developed may continue into adulthood.¹ National organizations continue to recommend that adolescents have regularly scheduled preventive health visits with an emphasis on comprehensive screening and health counseling.^{2,3}

Both parents and adolescents indicate that they wish their health care provider would discuss a broad range of health issues. However, in a national survey of adolescents, only 37% said that their physicians had addressed any of the health risk behaviors that the adolescents wanted to

discuss.⁴ If physicians (includes nurse practitioners) did discuss these topics, adolescents were more likely to be satisfied with the visit.

It is a challenge for health care providers to comprehensively assess and discuss key issues in visits that may be 30 minutes or less. Screening before the adolescent health visit can increase discussion of a wide range of issues.^{5,6} However, providing consistent, confidential screening before all visits is logistically difficult for many practices, and screening and health counseling rates remain low.^{7,8} Similarly, although computer-based health risk screening and education programs have been effective,^{9,10} many practices lack the resources (space and computers) or staff to implement them. With the availability of inexpensive personal digital assistants (PDAs), a simpler, more convenient approach to patient self-administered health screening is now possible.

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The Healthy Teens Project sought to use PDA technology to enhance assessment and counseling for health risk behaviors at adolescent preventive health visits. The procedure combined a comprehensive health screening tool, relevant educational messages, and questions to assess the adolescents' readiness to change key health risk behaviors. This report describes the pattern of health behaviors and readiness to change found with the PDA-based screening tool and compares adolescents' assessments of PDA-enhanced visits vs usual care. Our hypothesis was that the use of the PDA at well visits would result in more discussion of health behaviors and individualized health counseling.

METHODS

This study was conducted as part of Prescription for Health, a national program funded by the Robert Wood Johnson Foundation. The aim of Prescription for Health was to develop and implement primary care innovations addressing 4 risk behaviors: poor nutrition, inadequate exercise, smoking, and alcohol use.

HEALTHY TEENS PDA-BASED SCREENING TOOL

The Healthy Teens Project created a new screening tool to enhance adolescent health behavior counseling in primary care. To develop the screening tool, a working group was established with academic faculty and community physicians from 3 pediatric and 2 family medicine practices who responded to an invitation to members of the Clinicians Enhancing Child Health primary care practice-based research network at Dartmouth Medical School. Practices were in rural, suburban, and urban settings in New Hampshire and Vermont (population range, 1000-150 000).

Questions were adapted from the Guidelines for Adolescent Preventive Services.² The working group reviewed the Guidelines for Adolescent Preventive Services questions and compared them with their current assessment tools and interview questions. In addition, the following questions were added: 3 questions to screen sports participants for cardiovascular risks; branching questions to assess in more depth teenagers at risk for eating disorders and alcohol-related problems; and assessment of readiness to change if problems were identified for tobacco, alcohol or other drugs, inadequate nutrition, or sedentary behaviors. Readiness-to-change assessment determined adolescents' interest in changing the behavior, whether they had tried to change it before, and their confidence in being able to change. Brief educational messages about exercise as well as alcohol and tobacco use risks appeared on the PDA screen after the related questions. A confidentiality statement appeared at the beginning of the screening tool, and sensitive questions were placed at the end to enhance adolescents' comfort in addressing potentially sensitive issues.⁷

Two comprehensive PDA-based health screening tools were developed, one for adolescents 11 to 14 years of age and one for those 15 to 19 years of age. Each screening tool included 90 questions, but, for both age groups, the adolescent typically only needed to answer 60 to 65 core questions. Depending on which risk behaviors were reported, additional questions were asked. Content included: demographic characteristics, family and medical history, and personal health concerns; nutrition, physical activity, and body image; school, home environment, and safety issues; tobacco, alcohol, and other drug use; sexuality and relationships; and mental health and social conduct issues. Physicians had the choice of accessing all the answers with risks highlighted on the PDA or as a printed report.

With the support of the research team, the Clinicians Enhancing Child Health members first used their own practices as "laboratories" to test and revise the PDA screening tool. This initial feasibility pilot test, conducted by 5 physicians, addressed the format of the physician summary (paper report and PDA), the response threshold to be marked on the summary to encourage discussion, question content, software issues, acceptability to adolescents, and barriers to incorporating the screening tool into office routines. During the pilot test, physicians did not change the length of the scheduled visit, which was usually 30 minutes. Time to complete the screening tool averaged 9 minutes for older and 11 minutes for younger age groups. The most basic level of PDA model was used (approximate cost today, \$100; Palm; Palm Inc, Sunnyvale, California).

STUDY DESIGN

In the 5 study practices, during a 6-month period, patterns of adolescent health risk behavior and interest in health behavioral change were determined from the adolescents' responses during all health maintenance visits in which the PDA screening tool was used. These anonymous data were collected using age-appropriate HIPAA (Health Insurance Portability and Accountability Act) delimited identifiers and downloaded to a central database. The centralized electronic data collection methods used for this project have been previously described.¹¹

The content and quality of health screening and counseling was assessed before and after PDA screening was implemented. For a 2-week period, consecutive patients aged 11 to 19 years were asked by the front desk staff to complete anonymous written exit surveys following their health maintenance visit to 13 participating physicians in the 5 participating practices. Adolescents were given the survey following their visit and asked to return it to the front desk in a sealed envelope before leaving. The first sample was collected before PDA screening tool use and the second 6 months later, when PDA-based previsit screening was being used routinely as the only screening method. Physicians were unaware of which patients completed the survey. Survey items assessed adolescents' perceptions of the confidentiality of the visit, how carefully they felt the physician listened to them, and overall satisfaction with the visit. In addition, adolescents reported whether a discussion occurred for 8 health topics relating to sedentary lifestyle, diet, alcohol use, tobacco use, and mood and indicated whether the discussion was helpful. Adolescents have been shown to be accurate reporters of the physician's discussion of these topics from 2 weeks to 6 months later.¹²

The Institutional Review Board at Dartmouth College approved the study protocol. Parents were informed about practice participation in the PDA screening project and evaluation study through information posted at the front desk. More detailed information was available on request. Parents were told they could ask that their child not complete the anonymous survey (waiver of documentation of parental permission). The exit surveys were distributed after eliciting the adolescent's assent.

DATA ANALYSIS

Health risk screening data from the PDA tool were analyzed separately for younger (ages 11-14 years) and older (ages 15-19 years) adolescents because of variations in some questions asked of younger children. Within the screening tool, each question was categorized as positive or negative for a risk. From the list of all questions, the Healthy Teens Project working group defined question clusters and risk cutoff points for major health issues; an adolescent who screened positive merited discussion of the risk factor during the physician visit. The 10 health risks and cutoff points were (1) poor nutrition (<3 servings of fruits/vegetables or <3

Table 1. Health Risks Detected With PDA Screening During Preventive Visits^a

Health Risk Behavior	Ages 11-14 y (n=413)	Ages 15-19 y (n=639)	P Value
Poor nutrition	248 (60.0)	389 (60.9)	.80
Inadequate exercise	61 (14.8)	159 (27.1)	<.001
Excess screen time	94 (22.8)	162 (25.9)	.38
Inadequate injury prevention ^b	149 (36.1)	229 (35.8)	.95
Tobacco use in past month	7 (1.7)/413	79 (12.4)	<.001
Alcohol use problems ^c	15 (4.1)/368	57 (8.9)	<.001
Drug use	38 (9.2)	81 (12.7)	.09
Disordered eating attitudes	9 (2.2)	22 (3.5)	.27
Emotional issues	137 (33.2)	187 (29.3)	.19
Sexual activity ^d	21 (5.1)/366	188 (32.5)/578	<.001
Sexually active with inadequate protection	NA	120 (20.8)/578	
No. of risk behaviors, % of participants			
0	87 (21.1)	102 (16.0)	.03
1-2	202 (48.9)	275 (43.0)	.07
3-5	116 (28.1)	217 (34.0)	.06
6-9	8 (1.9)	45 (7.0)	.001

Abbreviations: NA, not applicable; PDA, personal digital assistant.

^aData are given as number (percentage) of participants unless otherwise indicated. If data are missing for some participants, the total sample size is given.

^bSeat belt and bike helmet use.

^cAny episode of drunkenness and drinking in past month for adolescents aged 11 to 14 years or positive CRAFFT (Car, Relax, Alone, Forget, Friends, Trouble) questions screening for alcohol use problems for adolescents aged 15 to 19 years.

^dSexual activity risk for adolescents 11 to 14 years of age defined as already being sexually active; for 15- to 19-year-olds, defined as being sexually active without protection (not using condoms or other birth control).

servings of dairy products per day); (2) inadequate exercise (moderate exercise for 30 minutes <3 times per week); (3) excess screen time (television watching >2 h/d and >1 h/d recreational computer use); (4) inadequate injury prevention (not always wearing a seat belt or not usually wearing a bike helmet); (5) tobacco use (use in the past month); (6) alcohol use (≥ 1 positive answers on the CRAFFT [Car, Relax, Alone, Forget, Friends, Trouble] questions¹³ [ages 15-19 years] or ever having been drunk along with current drinking in the past month [ages 11-14 years]); (7) drug use (use of marijuana or over-the-counter drugs to get high or sniffing/huffing [ages 11-14 years] or use of marijuana or over-the-counter drugs to get high [ages 15-19 years]); (8) sexuality (sexually active [ages 11-14 years] or sexually active without use of condoms or birth control [ages 15-19 years]); (9) disordered eating attitudes (not satisfied with eating habits and eating in secret or poor body image and excessive dieting or purging); and (10) emotional issues (recent sad/depressed mood or any history of suicidal ideation or attempt). Physicians selected ever being drunk (younger adolescents) and problematic drinking (older adolescents), rather than ever drinking, as requiring immediate intervention. The proportion of adolescents reporting each risk behavior and multiple risk behaviors was calculated for each age group. Differences between the risk behavior patterns for younger and older age groups were analyzed using χ^2 and Fisher exact tests.

Cross-sectional exit surveys were analyzed using χ^2 and Fisher exact tests to compare proportions for responses in the before and after samples. In the analysis of overall satisfaction, practice-level differences were assessed, but there were insufficient numbers to compare at the practitioner level. For this exploratory study, significant findings ($P < .05$) and trends ($P < .10$) are provided.

During a 6-month study period, 1052 adolescents (413 aged 11-14 years and 639 aged 15-19 years) completed PDA-based health screening during well visits to 13 participating pediatricians. Practices routinely used the PDA before adolescent health visits. Logistical and staffing issues sometimes limited the number of adolescents who completed the screening.

PDA HEALTH SCREENING RESULTS

Adolescent health risk behaviors, as reported on the PDA screening tool, are provided in **Table 1**. The most common health issues were related to obesity (diet, exercise, and television/computer use). Among adolescents aged 15 to 19 years, 8.9% screened positive for alcohol problems on the CRAFFT questions, and, among younger adolescents, 4.1% reported having been drunk. Not surprisingly, risk behaviors were more common among older adolescents. The cumulative number of risks, shown in Table 1, reveals that most adolescents had a limited number of major health risk behaviors, and multiple risk behaviors were more likely among older adolescents. For a small proportion of adolescents, physicians faced the challenge of addressing multiple risk behaviors (≥ 6) during the visit.

Interest in changing the risk behavior, previous attempts to change the risk behavior, and confidence that they could change the risk behavior were assessed when an adolescent scored above the cutoff point for any of the 5 Prescription for Health behaviors (nutrition, exercise, alcohol and other drug use, and tobacco use). Physicians were informed about these responses before the visit, so they could use this information to direct their counseling. Adolescent interest in making a change differed markedly by health risk behavior. There was strong interest in nutrition and exercise and very little interest in changing alcohol consumption. Most younger and older adolescents who reported a nutritional risk behavior were interested in eating healthier (62% and 71%, respectively). Similarly, there was strong interest in exercising more among adolescents who reported inadequate exercise (younger and older adolescents, 69% and 80%, respectively). Among 15- to 19-year-olds, 38% of those who used tobacco in the past month were interested in trying to quit, 25% of those who used marijuana or other drugs in the past month were interested in changing their drug use, and only 8% of those who used alcohol in the past month were interested in changing their drinking. For the younger adolescents, we do not have sufficient data to report interest in changing risk behavior for tobacco, alcohol, or substance use because lower levels of use were reported for the prior month and half the younger adolescents elected to not answer questions about these topics.

EXIT SURVEY RESULTS

Exit surveys were completed by 65 adolescents before and by 98 adolescents after PDA screening was implemented. Exit surveys were completed after 70% to 90% of well visits, and completion rates within practices did not differ be-

Table 2. Adolescents' Appraisal of the Visit Before and After Introduction of the PDA Screening Tool^a

Question	Before PDA (n=65)	With PDA (n=98)	P Value
How satisfied were you with this office visit? ^b	41 (63.1)	86 (87.8)	<.001
Did the [clinician] listen carefully to you? ^b	42 (64.6)	86 (87.8)	<.001
Did you feel your discussion with the [clinician] was confidential? ^c	40 (61.5)	82 (83.7)	.002
Was there something that you would like to talk to your [clinician] about but didn't? ^c	7 (10.8)	2 (2.0)	.03

Abbreviation: PDA, personal digital assistant.

^aData are given as number (percentage of participants) unless otherwise indicated.

^bVery (1) vs all other responses (2-7) on a 7-point scale.

^cYes vs no/not sure.

Table 3. Adolescent-Reported Health Topics Discussed and Helpfulness of the Discussion^a

Health Topic	Topic Discussed			Discussion Reported as Very Helpful ^b		
	Before PDA (n=60)	With PDA (n=91)	P Value	Before PDA	With PDA	P Value
Fruit/vegetable intake	25 (41.7)	55 (60.4)	.03	8/25 (32.0)	32/55 (58.2)	.03
Milk products intake	27 (45.0)	47 (51.6)	.51	12/27 (44.4)	33/47 (70.2)	.03
Exercise	38 (63.3)	61 (67.0)	.73	15/38 (39.5)	35/61 (57.4)	.08
Television viewing	19 (31.7)	34 (37.4)	.49	6/19 (31.6)	16/34 (47.1)	.39
Tobacco use	24 (40.0)	50 (54.9)	.07	15/24 (63.4)	35/50 (70.0)	.59
Alcohol use	23 (38.0)	50 (53.9)	.046	14/23 (60.1)	30/50 (60.0)	>.99
Drug use	23 (38.3)	36 (49.6)	>.99	14/23 (61.0)	24/36 (66.7)	.78
Mood issues	24 (40.0)	38 (41.8)	.87	9/24 (37.5)	20/38 (53.0)	.30

Abbreviation: PDA, personal digital assistant.

^aData are given as number of participants (percentage of participants) unless otherwise indicated. If data are missing for some participants, the total sample size is given.

^bAmong adolescents whose physicians discussed the topic at a well visit. Discussion was reported as very helpful vs somewhat or not helpful.

fore and after PDA screening. There was no significant difference in sex or physician specialty (family medicine vs pediatrics). Before PDA screening, surveys showed that 17% of adolescents were screened with a paper questionnaire. After PDAs were introduced, 2% were screened with paper questionnaires and 97% were screened with a PDA.

Adolescents' appraisal of their health visits both before and after PDA screening was implemented is shown in **Table 2**. After PDA screening, adolescents rated several aspects of their visits more positively. They thought they were listened to more carefully, had fewer unanswered concerns, were more likely to believe their discussion was confidential, and had higher overall satisfaction with the visit.

Adolescents reported whether any discussion of 8 key health topics had occurred during the visit (**Table 3**). Discussion could include either prevention or change in current risk behavior. After the PDA screening tool was implemented, there was an increase in the proportion of visits in which fruit/vegetable intake, tobacco use, and alcohol use was discussed.

Although use of the PDA screening tool increased the frequency with which certain health topics were discussed, we were also interested in any effect on the perceived quality of discussions. We assessed how often adolescents reported that discussion with their physician was very helpful (Table 3). This analysis is limited to the adolescents who actually discussed a topic. When PDAs were used, there was a trend for adolescents to perceive the

discussions of exercise as more helpful, but only the differences in perceived helpfulness for nutrition topics were statistically significant.

PHYSICIAN FEEDBACK

Physicians discussed how they used the PDA screening tool in debriefing meetings with our research team. They found it helpful to screen comprehensively before meeting with an adolescent, so they could spend their limited time in relevant discussion and counseling. The format of the PDA report allowed the physician to distinguish quickly between the small number of high-risk adolescents reporting multiple health risk behaviors and those reporting fewer risk behaviors or whose peers participated in risky behaviors (eg, use of tobacco and alcohol and other drugs). As has been previously reported,¹⁴ physicians found it difficult to effectively address multiple health risks in one visit. The PDA screening tool helped physicians set priorities about which issues to address. Physicians said issues such as depression, eating disorder issues, alcohol or drug use, concern about sexual orientation, or unprotected sexual activity became top priority when present.

Each practice was encouraged to use the PDA screening tool for all adolescent well visits. Practices reported that adolescents rarely refused to complete the screening. Completion of the screening tool was more dependent on whether practice staff gave the adolescent a PDA. System barriers, such as staff turnover, being too busy, or the pa-

tient arriving late, were commonly cited. Lack of time and other commitments were the most common reason adolescents gave for not completing the exit surveys.

COMMENT

Simple and inexpensive PDAs are a feasible platform that improves the comprehensiveness of screening and the quality of the patient-physician interaction during adolescent well visits. The PDA screening tool augmented the counseling process in 2 ways. Physicians did not need to devote time to screening questions and instead began the visit with a clear summary of the issues that needed to be addressed. In addition, physicians knew about the adolescent's interest in making changes in key health risk behaviors. When physicians were given information about the adolescent's motivation to change, more discussion occurred for 3 of 5 health risks. In addition, adolescents who had PDA-enhanced visits viewed interactions more positively than did adolescents seen before the adoption of the Healthy Teens Project.

Although adolescents' interest or motivation to change has been measured in research settings,^{9,15-17} this is the first study we are aware of that assessed motivation to guide counseling during routine primary care. Although limited by the small number of younger adolescents reporting substance use, these preliminary results show that motivation to change varies by age and health risk. Gathering information on readiness to change various health risk behaviors can enhance the physician's counseling. When counseling is tailored to motivational stages, it has been shown to be effective in changing adolescent substance use, nutrition, and exercise.^{9,17,18}

Were these adolescents willing to reveal sensitive information to their physicians via PDA screening tools when confidentiality was offered? For many of the risk behaviors, comparable data are not available for adolescents who attend primary care practices. Reporting alcohol problems is one sensitive area in which PDA responses can be compared with other methods of gathering information in primary care practices in our region. Recently, adolescent rates of positive screening using the CRAFFT questions ranged from 8% to 29.5% in a variety of school and health clinic settings in New England.¹⁹ There was an 8% positive rate in a pediatric clinic in which 93% of visits were well visits. This is comparable to our rate of 8.9% for positive CRAFFT screenings using the PDA screening tool. In our earlier longitudinal study of middle school-aged children in New England primary care practices,²⁰ on mailed surveys 4% of 13- to 14-year-olds reported ever having been drunk (A.L.O., unpublished data, 2000) compared with 4.6% of younger adolescents who reported ever having been drunk using PDA screening in this study. When provided a computerized option for substance use screening, adolescents have preferred it to verbal inquiry from a nurse or physician and did not differ in what they were likely to reveal.²¹ For some sensitive issues for which physicians rarely screen,²²⁻²⁴ the PDA format ensures screening and is a more comfortable way for the adolescent to disclose information. Among adolescents 12 to 19 years of age, 2.5% reported gay/lesbian/bisexual concerns they wished to dis-

cuss, and prior suicidal thoughts or plans were reported by 9% of younger and 20% of older adolescents.

Aside from willingness to inform their physician, this population of adolescents who attended well visits was likely to differ from adolescents who used only acute care services or are surveyed in school venues with the Youth Risk Behavior Survey. Adolescents who have preventive health visits have been shown to have fewer emotional and other health risks than those who only use acute care.²⁵ In a New York rural community, the rates of tobacco, alcohol, and marijuana use were 4 to 7 times higher on the Youth Risk Behavior Survey than among the adolescents screened with Guidelines for Adolescent Preventive Services paper-based questionnaires at primary care health visits.⁶ Although some of these adolescents may have been unwilling to share information with their physician, we think we are more likely to be reporting health risk data on a lower-risk population attending health visits. With poor nutrition, sedentary behaviors, safety issues, and emotional concerns commonly occurring and a substantial number of risk behaviors to discuss, the health of adolescents who have preventive health visits appears suboptimal.

This was a small, exploratory study conducted in 5 community practices willing to use new technology. In addition, the impact study was conducted in one region with a primarily white, middle-class population. Therefore, our findings may have limited generalizability to different kinds of practice settings. Although the PDA screening tool was based on widely used measures, further work is needed with other populations and ethnic groups. We were limited in our analyses by the small study population and were only able to assess practice effects; further work needs to assess variations by physician.

Our findings raise several questions that merit further investigation. Previously, a clinical skills training component, rather than support for the implementation of screening questionnaires, resulted in more counseling about 5 health risks.²⁶ Physician training was not the primary focus of the Healthy Teens Project, yet counseling was enhanced. The PDA screening tool may perform dual functions that influence physician counseling. First, it profiles adolescents' risks, then helps physicians understand the adolescents' concerns and readiness to change. Incorporating more physician training in readiness to change and brief motivational interviewing when using the PDAs could increase the effectiveness of health behavior counseling. Interventions using a motivational interviewing approach have been effective with adolescents but have required additional time, staff, or resources not available to most primary care providers.^{17,18} More study of practical, brief approaches conducted within the visit is needed. Few studies determine adolescent actions after health counseling by their primary care provider, and this also needs to be addressed in future research.

CONCLUSION

This study suggests that a new approach using inexpensive technology has the potential to make routine compre-

hensive screening of adolescents feasible in primary care. This method significantly enhances the content addressed and how the adolescents view the well visit. This electronic screening tool needs to be distinguished from the use of technology by the physician. Although electronic medical records can cue the physician to ask about health issues more consistently, only when the physician has the adolescent's information before the visit can the limited time be used more effectively to discuss and counsel.

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