

# An Internet-Based Program to Improve Self-Management in Adolescents With Type 1 Diabetes

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**OBJECTIVE** — To report results from YourWay, an Internet-based self-management intervention for adolescents with type 1 diabetes.

**RESEARCH DESIGN AND METHODS** — A total of 72 adolescents with type 1 diabetes, ages 13–17 years, were randomized to a usual-care-plus-Internet support or a usual-care group. The intervention was designed to enhance problem-solving barriers to self-management. A1C was obtained from medical records, and problem-solving and self-management were obtained via adolescent report.

**RESULTS** — Group differences were not statistically significant using intent-to-treat analyses. Using as-treated analyses, adolescents in the treatment condition showed statistically significant improvement in self-management ( $d = 0.64$ ;  $P = 0.02$ ) and important improvements in problem-solving ( $d = 0.30$ ;  $P = 0.23$ ) and A1C ( $d = -0.28$ ;  $P = 0.27$ ). Mean A1C for the intervention group remained constant ( $-0.01\%$ ), while the control group increased ( $0.33\%$ ).

**CONCLUSIONS** — This brief trial suggests that self-management support delivered through a secure website may improve self-management and offset typical decreases in adolescent glycemic control.

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Young people with type 1 diabetes typically experience a decline in glycemic control (A1C) through adolescence (1,2). Risk factors associated with increasing A1C include hormonal changes and barriers to self-management such as competing demands, inadequate planning and communication, peers and social situations, and negative emotions (3–5). Problem-solving and coping with diabetes barriers are skills that have been positively related to diabetes outcomes and are recommended as part of diabetes education (6,7,14). Previous studies have not used the Internet as a modality to teach problem solving with this population. We present the results of a small ran-

domized trial examining YourWay, an Internet-based program to improve adolescent problem solving, self-management skills, and glycemic control. We hypothesized that problem solving and self-management skills would improve for the intervention group.

## RESEARCH DESIGN AND METHODS

Adolescents with type 1 diabetes were randomly assigned to receive usual care or usual care plus Internet-based problem-solving self-management support. Eligible participants within the Vanderbilt Eskind Pediatric Diabetes Clinic were 13–17 years, had Internet access, were diagnosed with type 1 diabetes for at least 6

months, spoke English, and had no disabilities that precluded understanding website content.

Between July and November 2008, participants were block randomized at 2:1 to the intervention group in sets of six. Condition was revealed by the research assistant opening a sealed envelope, generated by the principal investigator. The study was approved by the Vanderbilt Institutional Review Board, and parental consent and adolescent assent were obtained at study initiation.

## Intervention

Intervention components were designed based on learning, social-cognitive, and self-determination theories (8,9). A multidisciplinary team of diabetes professionals and young patients wrote and edited website content. During 11 weeks, six multimedia stories depicted psychosocial barriers to self-management (e.g., time pressure, competing demands, and embarrassment) and approaches to coping and problem solving. Participants were prompted twice to complete problem-solving cycles for personal barriers to self-management. Other activities included 1) a personalized homepage, 2) multimedia presentations on the steps of problem solving and how to use the website, 3) social networking via a peer forum, 4) social comparison of their responses compared with other adolescents, 5) help from a problem-solving expert, and 6) weekly emails that encouraged participation. Participants had no interactions with diabetes clinicians or parents through the YourWay website.

## Measures

A1C corresponding to baseline visit and the most recent A1C after the intervention period were collected from medical records. Behavioral measures were administered at baseline and 12 weeks. Adherence was assessed using the Diabetes Behavior Rating Scale (10). Problem solving was measured by the Diabetes Problem Solving Behaviors scale, a novel 27-item self-report scale that assesses frequencies of problem-solving behaviors associated with diabetes self-manage-

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ment. Internal consistency of this scale was adequate within this study (Cronbach's  $\alpha = 0.89$ ).

Intervention participants reported their perceptions of the stories after viewing each (responses: 1 = worst to 5 = best). A semi-structured telephone interview with intervention participants assessed technical barriers, satisfaction, and the extent of parent interactions with the adolescent.

### Statistical analysis

Intention-to-treat analysis included all randomized subjects with available data at baseline and end of study. A conservative version of Cohen's  $d$  repeated-measures effect size, using the largest of the two group SDs, was used to compute the differences in change over time between the intervention and control groups (11). The test of the interaction effect of group assignment on each outcome using a standard 2 (intervention, control)  $\times$  2 (time of assessment) mixed-design ANOVA was used for the assessment of statistical significance. SPSS Version 17 was used for analyses.

**RESULTS**— No statistically significant differences between the groups existed at baseline (Table 1A, available in an online appendix at <http://care.diabetesjournals.org/cgi/content/full/dc09-1881/DC1>) with the exception of A1C, which was higher for the intervention group ( $P = 0.02$ ). No statistically significant group differences in change over time were found using intention-to-treat analyses.

When data were analyzed using an as-treated approach, the same patterns were seen for average group characteristics at baseline; however, problem solving improved by 0.30 SDs for the intervention group ( $d = 0.30$ ,  $P = 0.23$ , 95% CI 0.14–0.49). Self-management adherence improved compared with the control group ( $d = 0.64$ ,  $P = 0.02$ , 0.53–0.79). The intervention group A1C remained constant but showed improvement relative to the control condition, which showed worsening values ( $d = -0.28$ ,  $P = 0.27$ , 0.25–0.67) (Table 1). Although lower than the intervention group at post-study, the change between the first and second A1C measurements for the control group was +0.33% and for the intervention group was -0.01%.

### Intervention process variables

Most participants (63%) viewed all stories at least once (mean 5.2, SD 2.0, median

**Table 1**—As-treated effect sizes, means, and significance for relative group change in A1C, problem solving, and self-management

	Control (n = 18)		Intervention (n = 34)		Effect size (P)
	Baseline	Post	Baseline	Post	
Problem solving	3.4 $\pm$ 0.6	3.3 $\pm$ 0.7	3.5 $\pm$ 0.5	3.6 $\pm$ 0.5	0.30 (0.23)
Self-management	3.7 $\pm$ 0.4	3.7 $\pm$ 0.5	3.7 $\pm$ 0.4	3.9 $\pm$ 0.4	0.64 (0.02)
A1C	8.2 $\pm$ 1.2	8.5 $\pm$ 1.3	9.1 $\pm$ 1.9	9.1 $\pm$ 1.8	-0.28 (0.27)

Data are means  $\pm$  SD.

6), and 76% completed both problem-solving cycles (mean 1.5, SD 0.7, median 2). The stories were rated as highly relevant (mean 4.7 out of 5.0, SD 0.5) and realistic (mean 4.4, SD 0.5). A total of 35 subjects (73%) could be reached for an interview after the study period. Most participants (63%) gave the intervention an overall grade of "A" and the remainder (37%) gave it a "B." Adolescents reported that parent interactions related to the website included talking to them about the website (81%), viewing the website with them (58%), and/or helping with problem solving (42%).

**CONCLUSIONS**— Previous research has indicated a general trend of increasing A1C during adolescence. A brief Internet-based self-management intervention was rated highly by participants and was effective at improving problem solving and self-management and appeared to offset the typical adolescent increase in A1C. To our knowledge, this is the first trial of an Internet program to improve problem solving in type 1 diabetes adolescents and the first intervention in this area that does not require additional clinician effort. The study is limited by a brief intervention period, small sample, and a lack of randomization on A1C values. The range of effect sizes observed within this short-term study (0.28–0.64) is consistent with other typically longer-duration, problem-solving, and coping intervention studies using a face-to-face modality (12–15) and suggests that an Internet-based intervention is a feasible and accessible means of improving diabetes care. Further research is necessary to establish efficacy with a larger randomized trial, integrate parents and clinicians, fully validate the problem-solving measure, and identify issues in sustainability.

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