

***Bridge-It*: A System for Predicting Implementation Fidelity for School-Based Tobacco Prevention Programs**

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Abstract Properly implemented school programs to prevent tobacco use and addiction can lower smoking prevalence up to 60%. However, numerous programs are not successful due to poor implementation. A system for estimating likelihood of future implementation fidelity of school-based prevention programs was tested using data collected at baseline and two year follow-up in 47 middle schools and high schools participating in the Texas Tobacco Prevention Initiative. The *Bridge-It* system includes an eight-factor, 36-item survey to analyze capacity for program implementation and a companion Bayesian model which provides estimations of likelihood of implementation fidelity several years after program initiation. The survey also asks about amount of implementing activity for each of the multiple components recommended in federal guidelines for school programs to prevent tobacco use. Criterion referenced cross-tabulations showed the system's forecast of implementation fidelity was correct in 74% of cases ($p < .01$). Model reliability was confirmed in regression analyses. Implementation fidelity at follow-up was predicted by the combination of the model's eight capacity factors at baseline. It includes program, implementation support, and non-program factors. Integration of the *Bridge-It* system, or comparable tools, into the dissemination and evaluation of school-based prevention programs

can help to increase understanding of factors that influence implementation and provide guidance for capacity building. If administrators can identify at baseline schools likely to fall short of implementation goals, plans for resource allocation and provision of guidance, training, and technical assistance can be specifically tailored to identified needs.

Keywords Tobacco · Prevention · Schools · Implementation

Introduction

School programs should be part of comprehensive strategies for preventing tobacco use and addiction. With more influence in the lives of youth than any other social institution except the family, schools help to develop and reinforce the norms that govern adolescent and adult behavior. Reaching children in school with information and services to prevent and reduce tobacco use is, therefore, important to the establishment and maintenance of future smoke-free norms. When properly implemented, school programs can lower smoking prevalence by 25–60% (National Cancer Policy Board, 2000). Studies in Indiana, for example, showed students completing a curriculum-guided program were more knowledgeable than their peers about the health effects of smoking. At follow-up, those in the curriculum-guided programs were 40% less likely to be current smokers (Zollinger *et al.*, 2003). Studies in Texas showed similar results for school-based programs combined with a media campaign. The average rate of tobacco use was 40% lower for program students than those at comparison schools (Meshack *et al.*, 2004).

Unfortunately, the amount of return realized from investments in school-based prevention programs often is much

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less than desired (Rooney & Murray, 1996). Low or failed implementation is a common explanation for failed outcomes (Pentz, 2003; Mihalic & Irwin, 2003). A study in Oregon, for example, showed significantly less decline in smoking prevalence among students at schools with lower levels, relative to higher levels of program implementation (Rhode *et al.*, 2001). The Oregon study reported high rankings on implementation criteria for only 9 of 38 schools that received small grants for programs to prevent tobacco use and addiction. The implementation success rate was only 24%.

Low or failed implementation is not unique to prevention of tobacco use. A study of master trainers' approaches for disseminating the Life Skills program to prevent use of alcohol and other drugs showed "only 49% of the trained teachers implemented one or more lessons with students" (Hahn, Noland, Rayens, & Christie, 2002). Only 25% of practitioners are reported to be implementing with fidelity parenting and family focused programs (e.g., Families and Schools Together) to prevent use of alcohol and other drugs (Kumpfer, 2002). During a four year period after healthy lifestyles curriculum kits were donated by the American Heart Association to 5,097 schools in Texas, the kits were used at only 27% of schools (Roberts-Gray, Solomon, Gottlieb, & Kelsey, 1998a, 1998b). Using funder-defined criteria for evaluating implementation of 10 School Health Centers, only 3 campuses (30%) were rated as a clear "success" three years after program initiation (Gingiss & Roberts-Gray, 1997). A process evaluation of the effectiveness of the "Know Your Body" curriculum in elementary and junior high schools showed 38 of 82 teachers (46%) had scores reflecting effective teaching of the curriculum (Taggart, Bush, Zuckerman, & Theiss, 1990). Implementation data for a six-district study of the Child Development Project to prevent problem behaviors showed 5 of the 12 intervention schools (42%) had accomplished wide-spread changes in program-relevant classroom practices by the end of the third intervention year (Battistich, 2000). A one-year follow-up of 11 schools in a project to prevent bullying showed 6 (55%) had developed dedicated bullying policies (Eslea & Smith, 1998). Innovations directly focused on students' academic performance also have less than optimal rates of implementation success (Fullan, 2005). Case studies of the NextDay technology and innovations project for K-12 schools, for example, showed 5 out of 11 (45%) were classified as having achieved successful implementation (Topper, 2000).

Indication that proper implementation is achieved in less than half of targeted schools is common, even though definitions of success are varied and measurement methodologies range from a single item on a questionnaire to complex, multi-source systems for assessing scope and fidelity of implementation. The context of studies in which frequency or rates of implementation fidelity are recorded range from the

relatively controlled environments of prevention trials to the challenges of wide-scale program dissemination. There also is notable variation in the complexity of the targeted interventions. Some have a single focus, such as a specific curriculum for classroom use. Others are bundles of innovations such as the recommendations of the Centers for Disease Control and Prevention (1994) for school programs to prevent tobacco use and addiction through development and enforcement of school policy, instruction for students, family involvement, and tobacco cessation support.

Many strategies are recommended to increase likelihood of implementation fidelity. These include implementation checklists and guidelines (Roberts-Gray, 1985; Steps for Successful Implementation, 2000), recruitment and training of campus-level change agents or program champions (Hall & Hord, 1987, 2001; Roberts-Gray *et al.*, 1998), templates for assessing and modifying amounts and types of implementation support (Roberts-Gray & Scheirer, 1988), incentives and financial support to build capacity for change (Parcel *et al.*, 1989), on-site coaching and technical assistance for implementers (Gingiss, 1993), workshops and videos for program implementers (Kam, Greenberg, & Walls, 2003), fully documented program manuals for training and supervising intervention staff and for monitoring program quality and performance (Mowbray, Holter, Teague, & Bybee, 2003), school-community partnerships (Spoth, Greenberg, Bierman, & Redmond, 2004) and technical assistance and independent monitoring to build capacity for implementation (Elliott & Mihalic, 2004). However, persistently low rates of success in achieving implementation fidelity indicate the need for additional study of ways and means to assist students, families, and communities to derive desired benefits from school prevention programs. Better understanding is necessary of factors that act as barriers and bridges in achieving implementation fidelity (Kumpfer, 2002; Greenberg, 2004), as is further attention to measuring and reporting the implementation status of school-based prevention programs (Elliott & Mihalic, 2004).

We report here a study of implementation of school programs in the Texas Tobacco Prevention Initiative in which the *Bridge-It* system (Bosworth, Gingiss, Pothoff, & Roberts-Gray, 1999) was used to collect and analyze data at baseline and again two years later at 47 secondary schools that received small grants to prevent and reduce tobacco use. The study purpose was to examine the validity of the *Bridge-It* eight-factor model for assessing baseline capacity for implementation success and predicting future implementation of school-based prevention programs. We used a broad definition of implementation fidelity that specifies the program components that are supposed to be delivered and identifies which are actually delivered (Scheirer, 1994). Hypotheses of the current study were that: (1) The *Bridge-It* system accurately predicts which schools will achieve implementation

fidelity measured two years later; and (2) All eight conceptual factors in the *Bridge-It* model for baseline capacity assessment are needed to provide an accurate forecast of implementation.

Methods

Description of the Texas tobacco prevention initiative

In 2000, the Texas Department of State Health Services (TDSHS) initiated a project to examine effectiveness of combinations of media campaigns, enforcement, cessation programs, and school and community programs to reduce and prevent use of tobacco (Texas Department of Health, 2001). Secondary schools spanning grades 6–12 in designated East Texas geographic areas were invited to compete for small grants for implementation of tobacco prevention programs. The competition was repeated for the following school year. Many but not all of the initial grantees participated in the second competition. The grant award was approximately \$2,000 annually to reimburse the school for expenses associated with its tobacco program. Additional guidance to build capacity for tobacco program implementation was provided through training and technical assistance sessions. Participation in the training sessions was a requirement of the grants. Training and technical assistance was designed to assist teachers and other school representatives to incorporate *Guidelines for School Health Programs to Prevent Tobacco Use and Addiction* (Centers for Disease Control and Prevention, 1994) into all facets of their tobacco program planning and implementation.

Study design

A prospective design was used. Capacity to implement tobacco prevention programs was measured at baseline. The baseline data were used to predict level of tobacco prevention program implementation two years later. The measures of capacity and implementation status were collected in surveys of school tobacco program coordinators in the Fall of school years 2000 and 2002. At baseline, the individuals who completed the surveys identified themselves as teachers (51%), counselors (17%), nurses or other health professionals (13%), school administrators (8%), Safe and Drug Free School Coordinators (6%), or/other professional staff (5%) such as social workers or Communities in Schools personnel. Because of personnel turnover and changes of assignments at the campus level, some of the survey respondents representing their schools in 2002 were different from the baseline respondents. This situation did not require adjustments to the data analysis procedures because campus was the unit of analysis and the survey items inquired about circumstances at the campus “during the current school year.”

Sample characteristics

All 111 schools in the targeted geographic areas that were recipients of the TDSHS Tobacco Prevention Initiative (TPI) grant awards in 2000 were eligible to participate. Ninety-three returned the baseline survey; 47 of these 93 also completed the follow-up survey and were eligible for inclusion in this study. To explore possible bias introduced because nearly half of the initial schools did not participate in the follow-up, we conducted chi square and *t*-tests to compare enrollment, demographic characteristics of the student body, grade levels, and baseline capacity scores of schools that did and did not participate in the follow-up. We found no significant differences. Both groups represented a diversity of secondary school campuses distributed across school districts in urban, suburban, and rural areas of East Texas. Approximately two-thirds (66%) of 2002 participants still had a program grant from TSDHS, whereas a third (34%) were no longer active in the grant program. Demographic characteristics of the schools are displayed in Table 1.

Measures of capacity for implementation

The survey items to measure school capacity for program implementation were taken from the *Bridge-It* survey tool, which was originally developed to help schools assess their capacity for implementing health education innovations and validated using the Integrative Group Technique (Bosworth *et al.*, 1999). The 36 questions assess eight factors related to

Table 1 Characteristics of the schools participating in the current study

	Number of schools ^a	Total (%)
Middle/Junior high schools	25	55
High schools	20	42
Alternative or private schools	2	4
Urban/Suburban	38	81
Rural	9	19
Enrollment less than 600	11	24
Enrollment 600–2000	28	61
Enrollment greater than 2000	7	15
Less than 33% economically disadvantaged	14	30
33–67% economically disadvantaged	19	41
Greater than 67% economically disadvantaged	13	28
More than 50% Black	2	4
More than 50% Hispanic	9	20
More than 50% White	24	52
No majority by ethnic group	11	24

^aData source: Texas Education Agency Public Education Information Management System (PEIMS) www.tea.state.tx.us accessed December 17, 2005.

program implementation—*Facilitation Process, Resources, School-based Leadership, Implementer Characteristics, External Environment, External Leadership, Compatibility, and Innovation Characteristics*. The factors are multi-attribute constructs with each attribute operationally defined as a single survey question with its own self-anchored ordinal scale. For example, an item within the *Implementer Characteristics* factor asks “Are the implementers willing to try the tobacco program?” Response options are “All or most are enthusiastic,” “Many are willing,” “Mixed: some are willing, others are not,” “Few to none are willing to try,” and “There is active opposition to the program.” A sample item within the *External Environment* factor asks “To what extent is the program consistent with federal, state, and district policies and guidelines?” Response options are “Policies strongly support/mandate this program,” “Policies can be interpreted as supporting/mandating this program,” “Policies recommend but do not require this program,” “Policies are vague,” and “No relevant policies exist.”

The expert panel that participated in the development of *Bridge-It* defined the questions, the response options, and the scoring procedures. Response options for each attribute/item are assigned ordinal codes from 1 = least to 5 = most desirable response. “Don’t know” or “No answer at this time” are coded 0. It was the consensus of the expert panel that responses with codes of 4 or 5 would be positively associated with future implementation success. Factor scores are calculated by counting the number of items with codes of 4 or 5 for that factor’s constituent attributes and comparing against the criterion values established by the expert panel for ordinal scores of “high,” “medium,” or “low.” The *Compatibility* factor, for example, has five attributes and is scored “high” when four or five, “medium” when two or three, and “low” when one or no attributes have codes of 4 or 5.

To produce a quantitative statement of probability of future implementation fidelity, *Bridge-It*’s mathematical model recodes the factor scores into likelihood ratios and applies the odds version of Bayes’ theorem (Phillips, 1973). Instead of weighting and summing the factor scores as would be done in a multi-attribute evaluation, the factor scores are expressed as likelihood ratios and multiplied. The likelihood ratios for a “high,” “medium,” and “low” score for each factor were empirically derived in analyses of the expert panel’s forecasts of likelihood of implementation success for hypothetical profiles (see Bosworth *et al.*, 1999). The factors, their attributes, the scoring rules and likelihood ratios are listed in Table 2.

In the current analyses, the probability statement was used as a measure of a school’s overall capacity to implement its local tobacco programs. Schools were categorized as “likely” to successfully achieve implementation fidelity when the baseline probability statement was greater than 40% and “unlikely” when 40% or lower.

Measures of implementation fidelity

Eight survey questions asked about implementation status. Respondents used a four-point scale (3 = extremely active, 2 = moderately active, 1 = low activity, 0 = no activity) to rate their school’s level of activity in implementing each of the following: (1) establishment or change of school policy on tobacco use; (2) enforcement of school policy on tobacco use; (3) instruction on tobacco prevention; (4) teacher training for tobacco prevention; (5) family involvement in student tobacco education and policy programs; (6) student cessation support; (7) faculty and staff cessation support; and (8) assessment of prevention programs.

Three measures of implementation were derived. The first measure was a mean activity score (range 0–3), indicating how much implementation activity was present at the school across the eight program components. The second measure was a count of the number of components for which there was at least moderate activity. The third measure was a categorical designation of “implementation success” based on the school’s being at least moderately active in implementing at least five of the eight components of school programs to prevent tobacco use and addiction.

Analyses

At baseline and again at follow-up, the scoring rules for the capacity for implementation measures and fidelity measures were applied to provide descriptive summaries of assessed capacity and implementation status. The obtained scores for the eight capacity factors at baseline were examined to identify common strengths and potential barriers and to forecast likelihood of future implementation fidelity.

Changes from baseline to follow-up were evaluated in paired samples *t*-test. Separate tests were run for the total capacity score, the eight capacity factors, the three measures of implementation fidelity, and raw activity scores for each of the eight components of school tobacco control programs.

Validity of the baseline capacity measures as predictors of implementation fidelity at follow-up was evaluated in linear and logistic regression analyses. To accommodate the small sample size, each of the predictor variables was run in separate linear and logistic models with the capacity score and the baseline implementation measure as predictors and the follow-up implementation measure as the dependent variable. To reduce risks for overestimating effects because of the large number of statistical analyses, we specified that effect sizes for the predictor variables would be inspected only for those cases in which the regression model explained a meaningful portion of the variance as indicated by obtained statistically significant R^2 greater than 0.30.

Accuracy of the categorical assignments of “likely” to successfully achieve implementation fidelity using the

Table 2 Conceptual model underlying the *Bridge-It* survey tool

Factor	Attributes	Scoring rules ^a	Likelihood ratios
Facilitation processes	Formal plan		
	Training for implementers	High: 5	2.57/1
	Technical assistance & coaching	Med: 3–4	1.29/1
	Monitoring and feedback	Low: 0–2	1/2.44
Resources	Communication channels		
	Materials		
	Staff	High: 6	2.18/1
	Funds	Med: 4–5	1/1.03
	Daily time	Low: 0–3	1/2.11
School-based leadership	Years allowed for campus trial		
	Facilities		
	Principal’s involvement		
	Program leader	High: 4	2.07/1
Implementer characteristics	Team structure/function	Med: 2–3	1/1.01
	Importance to principal	Low: 0–1	1/2.16
	Professional preparation		
	Commitment to health	High: 6–7	1.90/1
External environment	Implementation skills	Med: 4–5	1.09/1
	Willingness to try	Low: 0–3	1/2.23
	Role compatibility		
	Professional compatibility		
Compatibility	Perceived advantage		
	Stability outside school		
	Support		
	Opposition	High: 4–5	1.70/1
External leadership	Mandates and policies	Med: 3	1.13/1
	Bureaucracy	Low: 0–2	1/1.65
	Priorities		
	Structure	High: 4–5	1.56/1
Innovation characteristics	Student needs	Med: 2–3	1.11/1
	Culture	Low: 0–1	1/1.60
	Past success		
	Advocacy at district level	Active	1.60/1
Innovation characteristics	Complexity	Somewhat	1.11/1
	Relative advantage	Not active	1/1.25
	Ease of use	Not identified	1/1.52
		Low: 0–1	1/1.52

^aHigh, medium and low scores are assigned by counting the number of attributes with responses coded 4 or 5 and comparing against the scoring rules. Diagnostic power is the range between the largest and smallest likelihood ratio for each factor. This table is adapted from Table 2 in Bosworth *et al.* (1999).

cut-score of 40 on the overall baseline capacity score was tested in two-by-two chi-square analysis, with the categorical attainment of “implementation success” at follow-up as the dependent variable.

Statistical analyses were conducted using the Statistical Package for Social Sciences (SPSS for Windows, 2001).

Results

Capacity at baseline

The obtained baseline scores for the capacity factors are displayed in Table 3. Four of the eight factors had scores indicative of at least moderate levels of capacity

for successful implementation at the majority of the schools: *School-based Leadership*, *External Leadership*, *Compatibility*, and *Innovation Characteristics* each had medium or high scores at more than 50% of schools at baseline. *Implementer Characteristics* obtained medium or high scores at 46% of the schools and low scores at 54% of the schools. Three of the eight factors obtained low scores at nearly all (90%) of the schools at baseline: *Facilitation Processes*, *External Environment*, and *Resources*.

Attributes of capacity factors at baseline

To identify specific elements of school capacity that were potential barriers to implementation success, we examined

Table 3 Percent of schools with high, medium, and low scores for each of the eight capacity factors at baseline ($n = 47$ schools)

Factor	Low (%)	Medium (%)	High (%)
Facilitation processes	90	6	4
Resources	69	29	2
School-based leadership	40	48	12
Implementer characteristics	54	29	17
External environment	73	8	19
External leadership	40	27	33
Compatibility	30	25	46
Innovation characteristics	37	44	19
Total score	72	19	9

the constituent attributes within the factors and highlighted those for which more than two-thirds of respondents provided answers from the lowest points on the item scale. One attribute of *External Environment* met this criterion: 84% of schools lacked support from parents and community for their tobacco programs. For the *School-based Leadership* factor, the tobacco program was not seen as important to the school principal at 68% of schools. Two attributes of the *Resources* factor were identified as common threats to implementation success: 68% of campuses had inadequate amounts of daily time allocated for planning and implementing the new program, and 84% had allowed less than two years for program implementation. Four attributes of the *Facilitation Process* factor were marked as barriers to success: 72% of the campuses did not have access to multiple sessions of training for program implementers; 72% lacked on-going coaching and technical assistance; 74% lacked regular or frequent monitoring and feedback; and 94% had no written plans to guide program implementation.

Baseline predictions of likelihood of future implementation fidelity

When *Bridge-It's* Bayesian model was applied to the baseline capacity data, the resulting statements of likelihood of future implementation success for the schools' tobacco programs ranged from 1 to 98. The mean was 23.1 (standard deviation 0.29). The majority of schools (60%) had scores below 11. Only a few (9%) had a baseline capacity score as high as 70. When we applied the cut-score of 40 for evaluating the baseline responses to the *Bridge-It* survey, only 28% of the schools in this study were categorized as "likely" to successfully achieve implementation fidelity.

Changes in capacity from baseline to follow-up

Comparison of baseline and follow-up capacity data indicated a significant increase in the extent to which the *External Environment* ($t = 2.38$, $p < .05$) was supportive of the schools' tobacco programs. The percentage of schools with

high scores for *External Environment* increased from 19% at baseline to 26% at follow-up. At the same time, a significant decrease was noted from baseline to follow-up in the amount and/or qualities of *School-based Leadership* ($t = -2.47$, $p < .05$). At baseline 19% of participating schools had a high score for this factor, compared with only 2% at follow-up.

Four of the capacity factors remained relatively stable and modestly positive from baseline to follow-up. Medium or high scores were recorded at approximately half of schools at baseline and again two years later with respect to *Implementer Characteristics*, *External Leadership*, *Compatibility* and *Innovation Characteristics*.

Most schools (>95%) had low scores at both baseline and follow-up for the factors *Facilitation Processes* and *Resources*.

Changes in implementation status

A significant increase was documented from baseline to follow-up in the proportion of schools that were actively engaged in implementing tobacco prevention instruction for their students ($t = 3.96$, $p < .001$). At baseline, 38% of the schools were already extremely or moderately active in providing prevention instruction, compared with 87% reporting this level of activity at follow-up. However, no significant changes from baseline to follow-up were found in the amount of implementing activity for any of the other seven components identified by the CDC as best practice for school tobacco programs. These data are presented in Table 4.

At both baseline and follow-up, more than 70% of the schools were extremely or moderately active in enforcement of school tobacco policy. In contrast, less than 15% of the schools were moderately or extremely active in involving students' families in tobacco education and policy. Approximately one-fourth of the schools were at least moderately active in implementing faculty and staff cessation support at baseline and follow-up. Approximately one-third had at least moderate implementation activity at baseline and follow-up for teacher training, establishment or modifications of school tobacco policies, provision of student cessation and support, and program assessment.

A low level of implementation activity was indicated when the amount of implementation activity was averaged across the eight best-practice components. On a four-point scale ("extremely active" = 3 to "no activity" = 0), the average activity score at follow-up was 1.78 (standard deviation = 0.69), compared with 1.54 (standard deviation = 0.95) at baseline. This difference, while in the desired direction, was not statistically significant.

A count of the number of tobacco program components with at least moderate implementing activity confirmed low implementation fidelity at baseline and again at follow-up.

Table 4 Baseline and follow-up level of activity in implementing components of school programs to prevent tobacco use and addiction

Program component	Baseline		Follow-up	
	Mean	SD	Mean	SD
Establish or change school policy on tobacco use	1.00	1.05	1.06	0.86
Enforcement of school policy on tobacco use	2.42	0.94	2.23	1.12
Instruction on tobacco prevention	1.33	1.17	2.08	0.68***
Teacher training for tobacco prevention	0.83	1.02	1.21	0.92
Family involvement in student tobacco education and policy	0.73	0.74	0.79	0.65
Student cessation support	1.02	1.06	1.17	0.93
Faculty and staff cessation support	0.81	1.02	0.83	0.86
Assessment of prevention programs	1.13	1.00	1.27	1.00

Note: Level of activity scale: 3 = extremely active, 2 = moderately active, 1 = low activity, 0 = no activity.

*** $p < .001$

Out of the eight recommended components, the average number with at least moderate implementing activity was 2.73 (standard deviation = 2.49) at baseline and 3.40 (standard deviation = 2.05) at follow-up. This change was in the desired direction but was not statistically significant.

At follow-up, at least moderate activity in implementing five or more of the eight recommended components of school tobacco programs was recorded for 13 (28%) of the 47 schools. The 13 schools were categorized as having achieved implementation success.

Baseline capacity measures as predictors of implementation fidelity

Linear regression analyses in which the dependent variable was amount of implementation activity averaged across the eight best-practice components of school tobacco programs showed the *Bridge-It* baseline probability statement was a reliable predictor of implementation status at follow-up. Both the baseline implementation activity score ($\beta = 0.34$, $p < .05$) and the baseline probability statement ($\beta = 0.34$, $p < .05$) made significant contributions in predicting the amount of implementation activity at follow-up. Separate analyses for the factor scores indicated that *Facilitation Processes* ($\beta = 0.38$, $p < .01$) and *Resources* ($\beta = 0.32$, $p < .05$) made significant contributions in predicting the amount of implementation activity at follow-up. In both cases, however, the effect size for the baseline implementation activity score was greater than that for the factor score (baseline activity score $\beta = 0.39$ and $\beta = 0.41$, respectively).

Logistic regression showed the *Bridge-It* baseline probability statement also was useful in predicting categorical implementation success at follow-up ($p < .001$), with the effect size for the probability statement ($\beta = 2.30$) slightly greater than that of the baseline category score ($\beta = 2.20$). In their separate logistic regression models, three of the capacity factors contributed to significant prediction of categorical implementation success ($p < .01$), but the effect size for each of these factors was smaller than that for the baseline success score: *Resources* ($\beta = 2.14$ compared with $\beta = 2.45$ for

baseline success score); *School-based Leadership* ($\beta = 1.17$ compared with $\beta = 2.32$ for baseline score); and *External Environment* ($\beta = 1.10$ compared with $\beta = 2.53$ for baseline score).

In a final set of analyses, the categorical designation at baseline of “likely” to successfully achieve implementation fidelity was cross-tabulated with the categorical designation of “implementation success” at follow-up. The categorical forecast at baseline correctly identified 74% of the time schools actually achieved the criterion value for implementation success two years later ($\chi^2 = 7.87$, $p < .01$).

Discussion

An encouraging result of the current study is finding support for the hypothesis that the *Bridge-It* system for assessing school capacity to implement the prevention program accurately predicted which schools achieved implementation fidelity measured two years later. The *Bridge-It* survey tool and Bayesian model provided baseline forecasts of likelihood of implementation success that, two years later, were shown to be categorically correct in 74% of cases. Predictive validity of the assessment model was confirmed in regression analyses. At baseline, *Bridge-It* predicted 28% of schools would achieve implementation fidelity. At follow-up, 28% of the schools were at least moderately active in implementing at least five of the eight components of school tobacco programs. These data contribute to the literature documenting the high frequency of failed or low implementation of school-centered prevention programs.

This study also provided support for the hypothesis that all eight of the conceptual factors in the *Bridge-It* model for capacity assessment are needed to provide an accurate forecast of implementation. In regression analyses, the total baseline capacity score that included all eight factors was found to be more useful than its constituent factors as predictors of implementing activity at follow-up two years later. Results confirmed *Bridge-It*'s mathematical formula for combining the factors to calculate the overall score. In the original development and testing of the model (Bosworth *et al.*, 1999),

Facilitation Processes, Resources, School-based Leadership, and Implementer Characteristics were found to have substantially greater diagnostic power than the other factors. In the current study, separate analyses using each of the un-weighted ordinal factor scores as predictors showed the baseline measures of *Facilitation Processes, Resources, and School-based Leadership* were useful in combination with the baseline implementation measures in predicting amount of implementing activity and/or categorical implementation success at follow-up. As was the case in the original development of *Bridge-It*, however, the overall score that combined all eight factors was found to be most consistently useful in predicting implementation fidelity.

One of the reasons why the assessment model performed so well in predicting future implementation for the school tobacco programs was its firm foundation in research and theory. The expert panel that participated in development and initial validation of the *Bridge-It* survey tool and mathematical model included the perspectives represented in the Concerns Based Adoption Model (CBAM) for change in schools (Hall, 1992; Hall & Hord, 2001), diffusion theory as it applies to school programs (McCormick, Steckler, & McLeroy, 1995), the organizational context of program implementation (Scheirer, 1981; Roberts-Gray & Scheirer, 1988), planning for comprehensive school health (Allensworth & Kolbe, 1987), and planning and evaluating multi-component school-centered prevention and risk reduction programs (Fetro, 1991).

The *Bridge-It* model is consistent with results in the emerging literature on prevention programming in schools. Recent research indicates, for example, that state-recommended policies play a key role in determining the reach and quality of prevention programs at the school level (Blake *et al.*, 2005). *Bridge-It's External Environment* factor includes assessment of the extent to which the innovation/program is consistent with federal, state, and district policies and guidelines. The research and practice literature indicates that school-based prevention programs are unlikely to survive unless there is long-term planning (Greenberg, 2004 citing Adelman & Taylor, 1997). *Bridge-It's Facilitation Processes* and *Resources* factors include items to assess characteristics of implementation planning in the near- and long-term. The eight *Bridge-It* capacity-assessment factors also are consistent with the ten categories of attributes identified in the sustainability planning model recently developed for the Center for Substance Abuse Prevention (Johnson, Hays, Center, & Daley, 2004).

The *Bridge-It* assessment model fills a niche in a larger framework for promoting the success of prevention programs. The RE-AIM framework—Reach, Efficacy, Adoption, Implementation, Maintenance—includes recommendations for conducting “formative evaluation to get feedback on how your intervention will fit with [implementers’] usual

responsibilities and will fit into the organizational environment” and “record the extent to which participants and organizational settings complete or make use of the various components of your intervention” (Glasgow, 2002; Bull, Gillette, Glasgow, & Estabrooks, 2003). The *Bridge-It* assessment model was shown in the current study to fulfill these two tasks.

Results of this study provide additional confirmation of conclusions drawn in other studies that although implementer training is essential, training alone is not sufficient to ensure implementation fidelity (Dusenbury *et al.*, 2003). Nearly all schools participating in the current study obtained low scores at baseline and again at follow-up for *Resources*. The kinds of barriers represented in these factors are not easily or commonly addressed through training. To position for success, programs need adequate amounts and configurations of materials and supplies, staffing, funding, time, and facilities. Adequate facilitation processes and strong school-based leadership can help garner needed resources. A champion at district, regional or state level can be an additional valuable source of information and assistance regarding funding options.

Even though the schools represented in the current study are a self-selected sample that successfully competed for small grants to support their initiatives, the majority (60%) had baseline implementation capacity scores lower than 11 on a scale with absolute range 0 to 100 and obtained range 1 to 98. These results lead us to believe, like others, that any statewide or national school-centered initiative must include ample time and money for local capacity building (Elliott & Mihalic, 2004; Fullan, 2005).

Use of the assessment model to inform practice

Being able to predict which schools are likely to fall short of implementation goals could aid in directing training and technical assistance to support higher quality implementation of prevention programs. A baseline assessment to identify specific strengths and vulnerabilities at start-up can help to guide decisions about resource allocations, training, technical assistance, incentives, and policies to promote success.

The following recommendations for a sequential approach to program planning and provision of training and technical assistance are drawn from results of the current study to illustrate how capacity assessment at baseline might be used to help promote implementation success. The initial training made available to school personnel through the Texas Tobacco Prevention Initiative was appropriately focused on preparing classroom instructors to adopt and teach recommended curricula. An important concern noted in the baseline assessment data, however, was the lack of follow-up training. Despite the fact that participation in training was one of the contract requirements for this study's tobacco

program grants, only about one-third of school health coordinators reported access to on-going training, monitoring and feedback, or coaching and technical assistance. This perhaps explains why there was a statistically significant, substantial increase from baseline to follow-up in the amount of implementation activity schools invested in prevention instruction for students, but no significant changes in other components of the schools' tobacco prevention programming, and no increase in the overall amount of implementing activity. It is unrealistic to expect to address implementation of non-instructional components—such as family involvement, cessation services, and policy development—in a “one session fits all” manner at program startup. The facilitation of the implementation process could be strengthened by providing a sequence of training topics.

A sequential approach is especially important when the targeted program is a bundle of distinct, yet inter-related practices or components. Each component is likely to have a separate trajectory across user awareness, adoption, early trials, implementation, and maintenance stages of use. Strategies have been identified for analyzing implementation stages for multi-component programs and planning training consistent with user needs and concerns (e.g. Gingiss, 1992; Gingiss, 1993). Lacking a structured, sequential approach for planning and professional development, attempts to simultaneously implement all components in the first two years of grant funding may be beyond schools' capacity in view of internal competition with other school priorities. The baseline assessment in the current study indicated, in fact, that the tobacco program was not of foremost importance to the school principal at the majority of campuses. One option for recruiting higher levels of principal involvement is to use the baseline survey to keep the school principal informed about areas of strength. Other options are to invite the principal to participate in training provided for program coordinators or to provide a separate (briefer) training for school principals (Rohrbach, Graham, & Hansen, 1993; Kam *et al.*, 2003).

Study limitations

Conclusions drawn from the current study are limited by its relatively small sample size. Although we found no significant differences in characteristics (e.g., school size and type) or baseline capacity or implementation status between schools remaining in the study and dropouts, a larger sample size is needed to directly evaluate relative contributions of different capacity factors as predictors of future implementation fidelity.

Another limitation is the narrow, though convenient, measures of program implementation that were used in this study. The survey procedures did not produce measures of other aspects of program fidelity that often are cited in the research literature on implementation, such as exposure, quality of

program delivery, and participant responsiveness (Dane & Schneider, 1998; Dusenbury *et al.*, 2003). Although limited, the measures used here have the advantage of being simple to administer, easy to score, and meeting statistical demands for testing the Bayesian model. If the implementation measure had focused on other aspects of implementation fidelity, such as numbers of students and families exposed to the program components, amounts of engaged time, quality of delivery of instruction, or responsiveness of students and their families, it is likely that other factors in the *Bridge-It* system, such as *Implementer Characteristics*, which are frequent targets of training and support, may have proved to be stronger independent predictors of implementation.

Next steps

In addition to the need for additional studies with increased sample size and alternative measures of implementation success, additional research is needed to test the reliability and utility of the *Bridge-It* system with school centered programs other than tobacco prevention. While the model has been usefully applied in a variety of evaluation studies (e.g., evaluation of school-based health clinics, heart health and alcohol curricula, an early childhood immunization program), for the most part these studies have had small sample sizes and/or they lacked follow-up data to measure actual implementation. Additional study also is needed on how schools might use *Bridge-It* to help promote implementation success for prevention programs. For example, placement of the *Bridge-It* system on a password-protected website currently is being piloted as part of the Texas Tobacco Prevention Initiative. The goals of placing the system on the web are to assist schools in planning for implementation success, help program administrators identify strengths and needs, and provide a tracking tool for report generation.

Summary

Success of prevention hinges on effective dissemination and implementation of evidence-based programs. But implementation success is elusive. If administrators can identify at baseline schools likely to fall short of implementation goals, plans for resource allocation and provision of guidance, training, technical assistance, and support can be specifically tailored to meet identified needs. The *Bridge-It* survey tool and Bayesian model provided baseline forecasts that reliably predicted implementation of school programs to prevent tobacco use and addiction. The most consistently useful results were obtained with the overall measure that included all eight of *Bridge-It*'s conceptual factors, demonstrating that it is a combination of program factors, implementation support factors, and non-program factors that influence or at least explain some of the variation in achieved levels of implementation

fidelity. Development of implementation planning and support tools that address this range of factors can help to position evidence-based prevention programs for success in schools.

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