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*PROGRAM IMPLEMENTATION FIDELITY AND  
SUBSTANCE USE OUTCOMES AMONG  
MIDDLE SCHOOL STUDENTS IN A DRUG ABUSE  
PREVENTION PROGRAM*

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***ABSTRACT***

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Implementation fidelity is increasingly recognized as a key component of effective prevention programming. The present study examined the association between implementation fidelity and youth substance use outcomes among students in 11 New York City middle schools receiving a drug abuse prevention program. Trained observers monitored the

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implementation of a research-based prevention program by classroom teachers ( $N = 38$ ), and participating students ( $N = 1,857$ ) completed surveys assessing smoking and alcohol use over a 15-month period. Findings indicated that teachers who relied more on lecturing when teaching the program were less likely to use discussion and demonstration as teaching methods. Teachers who relied on lecturing were rated by observers as being less ready to teach and having poorer classroom management skills. Findings indicated that factors related to the quality of implementation significantly predicted change in student substance use outcomes. Students who were taught by the most skilled providers reported significantly lower increases in smoking and drinking at the follow-up assessments compared to students taught by other providers. These findings suggest that teacher training to enhance implementation fidelity is a crucial component to program success in terms of student behavioral outcomes.

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## RESUMEN

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La fidelidad en la implementación de programas está siendo cada vez más reconocida como un componente clave en los programas de prevención efectivos. El presente estudio examina la asociación entre la fidelidad en la implementación y los datos de consumo de drogas entre jóvenes estudiantes en 11 escuelas medias de Nueva York donde se han aplicado programas de prevención de drogas. Observadores entrenados supervisaron la implementación de un programa de prevención aplicado por profesores ( $N=38$ ), los alumnos participantes ( $N=1857$ ) completaron cuestionarios sobre el uso de tabaco y alcohol en un periodo de 15 meses. Los resultados indican que los profesores que prefirieron las clases magistrales cuando impartían el programa, utilizaban con menor probabilidad el debate y la demostración como métodos educativos. Asimismo, los profesores que prefirieron las clases magistrales fueron valorados por los observadores como menos preparados para dar clase y con menor capacidad de gestión de la clase. Los resultados indican que los factores relacionados con la calidad de implementación predicen significativamente el cambio en los datos de consumo de sustancias entre los estudiantes. Los estudiantes que asistieron a clase con los profesores con más habilidades presentaron significativamente menores incrementos de consumo de tabaco y alcohol en la fase de seguimiento, comparados

con los estudiantes que asistieron a clase con los otros docentes. Estos resultados sugieren que el entrenamiento de los profesores dirigido a incrementar la fidelidad de la implementación es un componente crucial para el éxito del programa en términos de los resultados de la conducta de los estudiantes.

The field of drug abuse prevention has produced a variety of effective research-based intervention programs that have been shown in rigorous evaluation studies to prevent the onset and escalation of alcohol, tobacco, and other drugs during adolescence (Hansen, 1992; Tobler & Stratton, 1997). While the number of research-based prevention programs has increased in recent years, a gap remains in what we know about how to effectively translate these programs into practice. A theoretical model that is useful for conceptualizing the process of bringing effective prevention programs to scale is the diffusion of innovations model developed by Rogers (1995). Diffusion of innovation refers to the process by which new knowledge is "communicated through specific channels over time among members of a social system," and this model represents a useful starting point for developing strategies to promote the use of efficacious programs and practices. Rogers proposes that the process of diffusing innovative health behavior interventions (such as evidence-based drug abuse prevention programs) involves four stages: dissemination, adoption, implementation, and maintenance. As described by Rogers, dissemination refers to the process by which effective innovations are spread or distributed, adoption refers to the decision processes by which organizations decide to use an innovation, implementation refers to the degree to which the program is delivered with fidelity to its' original design, and maintenance refers to how a program is institutionalized over time.

Research is needed on each stage of the diffusion process so that the public health benefits of evidence-based prevention programs can be realized. In fact, now that effective school-based drug abuse prevention programs have been developed and some have been widely disseminated and adopted, the challenges of program implementation and maintenance are of key interest. In terms of implementation, the challenge is to understand how and why implementation fidelity usually deteriorates when effective programs are taken from research to real world settings. Typically, the initial efficacy trials of prevention programs are under

the control of the program designer and implementation occurs under optimal conditions with high levels of funding, motivation, and support. The researcher generally exercises extreme care to ensure that the program is thoroughly understood by providers and implemented with a high degree of fidelity. In effectiveness studies, programs are disseminated to naturalistic settings under less favorable conditions, and the chances for inconsistencies in program delivery and for key program components to be modified become more likely (Dane & Schneider, 1998). In the next and final stage of dissemination, when programs are packaged and provided to prevention practitioners (i.e., end-users) for use in real-world school settings, implementation fidelity is most variable and in many cases fidelity is poor. For example, a recent study of research-based prevention programs in 104 school districts in 12 states found that only 19% of the schools were implementing the programs with fidelity (Hallfors & Godette, 2002). A growing concern is that as evidence-based programs are taken to scale, poor implementation fidelity may reduce effectiveness in real-world settings where teachers are not trained as well nor monitored when providing the program.

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### *THE IMPORTANCE OF PROCESS EVALUATIONS*

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As outlined by Rogers (1995), Backer (1991) and others, appropriate program implementation was long thought to be a relatively automatic event in the life of a program if it was truly innovative and the appropriate information was made available (Backer et al., 1995). Accordingly, the study of implementation process has been limited to date, and only recently have evaluation studies started to measure program implementation. For example, a review of 181 school-based prevention studies published from 1980 to 1990 in seven journals known for behaviorally based interventions found that only 15% measured implementation integrity (Gresham et al., 1993). Another review of over 1,200 published prevention studies found that only 5% provided data on program implementation (Durlak, 1997). Moreover, among studies that do measure implementation, many do not examine the relationship between implementation fidelity and program outcomes (Scheirer & Rezmovic, 1983). In a review of 34 rigorously evaluated programs to prevent mental disorders in school-age children, only 11 studies (32%) utilized implementation information in the outcome

analyses (Domitrovich & Greenberg, 2000). Dane and Schneider (1998) found that only 39 of the 162 preventive interventions they examined contained information on program integrity, and only 13 of these studies considered the impact of fidelity on outcomes.

Despite this relative lack of attention to implementation fidelity, research has clearly shown that implementation quantity and quality play a central role in how effective prevention programs will be. Studies that have included an analysis of implementation fidelity (i.e., process evaluations) have consistently shown superior outcomes when programs are implemented with high fidelity (Dane & Schneider, 1998; Gresham et al., 1993; Blakely et al., 1987; Gottfredson et al., 1993; Pentz et al., 1990). Indeed, in one of the largest meta-analyses of school-based substance abuse prevention programs, Tobler and Stratton (1997) concluded that problems related to program implementation have the largest impact in decreasing the effectiveness of these programs.

Generally, implementation fidelity refers to how well a program is implemented in accordance to the program as originally designed by the program developer. In practice, however, implementation fidelity is frequently operationalized as the quantity or amount of a program that is actually delivered to participants. There are, of course, many dimensions to effective implementation fidelity, and investigators have begun to make distinctions between the quantity of program delivered to participants and the quality of implementation, which includes a variety of factors such as the skill set, enthusiasm, preparedness, and attitude of the implementer. The various quantitative and qualitative aspects of implementation fidelity may have different relationships with program effectiveness, but little research has been done in this area to date.

The goal of the present study was to examine the relationships among different aspects of implementation fidelity and to what extent these implementation measures predict student substance use outcomes among youth participating in an effective school-based prevention program in an inner-city middle school setting. In our previous research we have found that program implementation is often more difficult in urban school settings relative to schools in suburban or rural settings. Thus, it is important to study the implementation process in urban schools, particularly inner-city schools.

## METHODS

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### SAMPLE

The data for the present study were collected as part of a school-based randomized drug abuse prevention trial for inner-city adolescents. Participants in the present study consisted of middle school students ( $N = 1,836$ ) who received the prevention program and classroom teachers ( $N = 38$ ) who provided the program to students. The analyses for the present study was limited to those students who received the preventive intervention (students from the control group in the larger randomized trial were not included in this study). The student sample was 50% male, predominantly African-American (33%) and Hispanic (35%), and included a large percentage of economically disadvantaged youth as shown by the fact that 58% received free lunch at school. A little more than one-quarter (29%) of students lived in mother-only households. The teacher sample consisted of 6th grade teachers (predominantly female) at 11 public and private middle schools in New York City.

### PROCEDURE

Students received a drug abuse prevention program consisting of a primary year of intervention (15 classroom sessions) in the 6th grade and a booster year of intervention (10 classroom sessions) in the 7th grade. Regular classroom teachers provided all intervention sessions after participating in a one-day training workshop. The preventive intervention, called LifeSkills Training (LST), aims to provide young people with the knowledge and skills needed to resist social influences to engage in substance use. The program also aims to increase general personal and social competence skills in order to reduce potential motivations to use alcohol, tobacco, and other drugs. Additional information on the goals, methods, and format of the prevention program can be found elsewhere (Botvin et al., 2001).

Data Collection. Data for the present study were collected following a detailed protocol approved by Cornell Medical College's Institutional Review Board. Sources of data included 1) student self-reports of current smoking and alcohol use; and 2) observational ratings of program

implementation fidelity made in the classroom by trained research staff. The student survey was administered at three time points. The pre-test assessment was conducted prior to the first year of intervention, the post-test assessment was conducted immediately after the first year of intervention (three months later), and the one-year follow-up assessment was conducted a year after the post-test assessment. Although all student measures were self-reported, data collectors emphasized the confidential nature of the data being collected in order to enhance the truthfulness of student responses. In addition, carbon monoxide breath samples were collected simultaneously with the questionnaire data to enhance the validity of the self-report data.

Research staff were trained to observe, evaluate, and document how well the program providers implemented the prevention program. Raters were trained with the use of videotape-recorded sessions and reliability was achieved when observers were within one degree of difference from their trainer. This was usually accomplished after viewing between 4 to 10 videotaped sessions. Once adequately trained, the classroom monitors rated teachers in terms of a variety of variables related to the quantity and quality of implementation fidelity. Of the 38 teachers in the present study, 23 received one observation, seven received two observations, seven received three observations, and one was observed a total of five times. For teachers receiving more than one observation an average score was calculated.

## MEASURES

**Student Data.** The student survey included several standard items assessing demographic data (e.g., gender, age, race) and items assessing substance use. The frequency of smoking was measured by asking "About how often (if ever) do you smoke cigarettes?" with response options on a nine-point scale anchored by 1 (never) and 9 (more than once a day). The frequency of drinking was measured by asking "About how often (if ever) do you drink beer, wine, wine coolers or hard liquor?" with the same nine-point response option format.

**Provider Data.** Trained observers completed a number of rating forms regarding program delivery, including 1) Implementation Quantity, or the percentage of curriculum objectives or Program Points Covered (PPC) by

the teacher during the session; and 2) Implementation Quality, as assessed by Teaching Methods used (percentage of time spent using Lecture, Demonstration, and Discussion in teaching the program), and Teacher Qualities as assessed by a series of items assessing the extent to which the teacher had a positive attitude, was well-prepared, and interacted appropriately with students. An inter-rater reliability coefficient of 0.80 for the Implementation Quantity (PPC) score was obtained based on teachers that were observed more than once by different research staff.

In order to examine the underlying factor structure of the Teacher Qualities scale described above, an exploratory factor analysis was conducted using principal components analysis with oblique rotation. A two-factor solution was obtained: seven items loaded highly on a Readiness To Teach factor, and three items loaded highly on a Classroom Management Skills factor. As shown in Table 1, the item loadings for the Readiness factor ranged from .81 for "teacher covers all major points of lessons" to .93 for "teacher conforms to LST curriculum" and the item loadings for the Classroom Management Skills factor ranged from .72 for "teacher has class deal with questions posed by students" to .92 for "teacher used positive reinforcement." Separate summary scores for Readiness and Classroom Management Skills were created by taking the mean of the relevant items and these scores were used in subsequent analyses.

## DATA ANALYSIS

Data were analyzed using correlations, multiple regression, and t-tests. First, the intercorrelations among the implementation variables were calculated. Second, a series of multiple regression analyses were conducted to examine to what extent implementation quantity and quality predicted student substance use outcomes over time. Third, in order to more closely examine the effects of Readiness To Teach and Classroom Management Skills on student outcomes, a series of t-tests were conducted. Analyses tested the hypothesis that students in classrooms where the prevention program was implemented more thoroughly by higher quality and skilled providers would show more benefit from the program as demonstrated by lower rates of substance use over time.



## RESULTS

Rates of substance use were low in the student sample. Prior to the prevention program, 7% ( $n = 138$ ) of students had previous experience with tobacco, and 19% ( $n = 406$ ) had experience with alcohol. These rates increased over time to 9% and 20% for tobacco and alcohol, respectively, at the post-test assessment and 14% and 26%, respectively, at the one year follow-up.

### CORRELATIONS AMONG IMPLEMENTATION VARIABLES

As shown in Table 2, the more that providers relied on Lecturing as a teaching method, the less likely they were to use Demonstration ( $r = -.66$ ) and Discussion ( $r = -.88$ ) in the classroom. Furthermore, those teachers that relied the most on Lecturing were rated by observers as being lower in Readiness to Teach ( $r = -.68$ ) and lower in Classroom Management Skills ( $r = -.41$ ). Thus, although Lecturing was positively correlated with the Implementation Quantity score (the percentage of Program Points Covered,  $r = .14$ ), it was negatively correlated with all other indices of implementation fidelity. Another notable finding was that the percentage of Program Points Covered (PPC) was significantly correlated with all other measures of implementation. In addition to being positively correlated with Lecturing, higher PPC was positively related to the use of Demonstration ( $r = .14$ ), Readiness To Teach ( $r = .31$ ) and Classroom Management Skills ( $r = .12$ ). However, PPC was negatively related to Discussion ( $r = -.17$ ). Taken together, these finding suggests that providers that rely on Lecturing are able to cover much of the curriculum, but they use less of other more effective teaching methods and are lacking in terms of other important qualities such as Readiness To Teach. Another notable finding was that use of Discussion as a Teaching Method – a key component of interactive prevention programming – was associated with fewer Program Points Covered. Since covering the material completely and allowing time for adequate discussion both would appear to be of central importance, an important next step is to examine the relationships between these (and other) implementation variables and student substance use outcomes.

## IMPLEMENTATION VARIABLES AND STUDENT SUBSTANCE USE

In order to examine more closely the impact of implementation variables on students' responses to the intervention, several additional analyses were conducted. Because substance use typically increases during early adolescence (even among participants in a drug prevention program), we expected that better program implementation would be associated with a smaller increase in student substance use rates compared to rates of increase among students in classrooms where program implementation was poor.

A series of multiple regression analyses were conducted to examine how the implementation variables predicted student substance use outcomes. In the first analysis, smoking change from the pretest to posttest was the dependent variable, and six implementation-related predictors were examined: Implementation Quantity (PPC), Teaching Methods (Demonstration, Discussion, and Lecture), and Teacher Qualities (Readiness to Teach, Classroom Management Skills). Findings indicated that the three Teaching Methods were significant predictors of Smoking Change, with each method predicting less of an increase in smoking from the pretest to posttest (Demonstration,  $\beta = -.16$ ,  $p < .016$ ; Discussion,  $\beta = -.32$ ,  $p < .005$ , and Lecture,  $\beta = -.36$ ,  $p < .022$ ). In this analysis, the Implementation Quantity or PPC score and the Teacher Qualities variables were not significant predictors of student smoking change. Furthermore, collinearity statistics indicated that there were high levels of multicollinearity among the predictors, and in particular among the three Teaching Methods (e.g., VIF = 43.5 for Lecturing). Therefore, in subsequent analyses, the two generally recommended Teaching Methods for contemporary prevention programs (Discussion and Demonstration) were retained in the model, along with the Implementation Quantity (PPC) score, whereas Lecturing was eliminated from the analysis to reduce the degree of redundancy among predictors. Findings indicated that Discussion was the only significant predictor of student smoking change ( $\beta = -.07$ ,  $p < .003$ ), whereas the Demonstration and PPC scores were not significant predictors. In the next analysis, the two Teaching Qualities (Readiness to Teach and Classroom Management Skills) were included in the model along with the Implementation Quantity (PPC) score to examine their relative contribution to smoking change. Findings indicated that Readiness To Teach was the only significant predictor of the student outcome ( $\beta =$

-.10,  $p < .004$ ), whereas the PPC and Classroom Management Skills scores were not significant predictors.

In summary, these findings indicate that the Implementation Quality variables, in particular, Discussion as a Teaching Method and Readiness To Teach, significantly predicted decreased student smoking over time. Additional regression analyses revealed that none of the implementation variables predicted pre-to-post drinking change or substance use change from the pre-test to one-year follow-up.

## A FOCUS ON TEACHER QUALITIES

The Teacher Qualities variables (Readiness to Teach and Classroom Management Skills) are constructs that were identified in a factor analysis of items in this study, and we conducted further analyses to examine their specific relationship to the student substance use outcomes. Based on plots of the data, it appeared that the benefits of Readiness To Teach and Classroom Management Skills became most evident at a threshold, such that students in the top fifth of classrooms showed substance use increases that were lower than students in the remaining classrooms. Therefore, in the next set of analyses, scores on Readiness To Teach and Classroom Management Skills were divided into quintiles and analyzed to determine if the students of teachers scoring in the highest 20% of these variables showed better substance use outcomes relative to students in the other 80% of classrooms.

Analyses were conducted for the pre-test to post-test time period first, as shown on the left-hand side of Table 3. Findings indicated that students in classrooms led by teachers in the highest quintile of Readiness To Teach had significantly lower rates of smoking increase than their peers in classrooms with less Motivated teachers,  $t(1464) = 2.5$ ,  $p < .014$ . Furthermore, students with teachers in the highest quintile of Classroom Management Skills had significantly lower rates of smoking increase than their peers in classrooms led by teachers with lower Classroom Management Skills,  $t(1615) = 2.5$ ,  $p < .014$ . However, this relationship was not observed for Readiness To Teach and drinking,  $t(1826) = 1.3$ ,  $p < .206$ , or Classroom Management Skills and drinking,  $t(844) = 1.0$ ,  $p < .308$ , as measured at the post-test assessment. These findings indicate that high implementation quality played an important role in the behavioral effects of the prevention program on youth smoking, although the effects

on alcohol use at the post-test assessment were not significant.

The next set of analyses examined change in student substance use behaviors from the pre-test assessment to the one-year follow-up assessment. Results are shown on the right-hand side of Table 3. Students of teachers in the highest quintile of Readiness To Teach had significantly lower rates of smoking increase at the one-year follow-up than their peers in the lower quintiles,  $t(668) = 2.6$ ,  $p < .009$  and also had significantly lower rates of drinking increase than their peers in the lower quintiles,  $t(1659) = 2.0$ ,  $p < .049$ . Furthermore, students of teachers in the highest quintile of Classroom Management Skills had significantly lower rates of smoking increase than their peers in the lower quintiles,  $t(806) = 2.4$ ,  $p < .019$ , and significantly lower rates of drinking increase than their peers in the lower quintiles,  $t(1490) = 2.3$ ,  $p < .020$ . Thus, higher Readiness To Teach and Classroom Management Skills were associated with decreased substance use outcomes in terms of both smoking and drinking at the one-year follow-up assessment.

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## DISCUSSION

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While the number of research-based prevention programs has increased in recent years, a gap remains in what we know about how to effectively translate these programs into practice. Research tells us that evidence-based prevention programs are generally not as effective when delivered by prevention practitioners in the field as in the original efficacy or effectiveness trials. The present study examined implementation fidelity among teachers providing LifeSkills Training program, an exemplary drug abuse prevention program that has earned recognition from national organizations such as the American Psychological Association, the Centers for Disease Control and Prevention, the American Medical Association, and the National Institute on Drug Abuse. Previous evaluation research has demonstrated that the LST program is effective among suburban, white youth (Botvin et al., 1990), with prevention effects lasting until the end of high school (Botvin et al., 1995; Botvin et al., 2000). Research has also shown that this approach is effective with inner-city minority youth (Botvin et al., 2001, 1992).

The LifeSkills Training program is one of the most widely used evidence-based programs for middle school students in the United States (Hallfors & Godette, 2002). Because LST has been widely disseminated

Table 1  
Factor Loadings of Teacher Qualities from Provider Monitoring Form

	Factor 1 Readiness to Teach	Factor 2 Classroom Management Skills
Teacher has a positive attitude toward students	.88	.61
Teacher has a positive attitude toward teaching the LST program	.88	.46
Teacher has a positive attitude toward teaching in general	.84	.58
Teacher appears to be adequately prepared to teach the session (the lesson proceeds in an orderly fashion, discussion does not wander, information is provided at appropriate times, etc.)	.85	.61
Teacher speaks clearly and intelligibly and has a generally good manner of presentation in the classroom.	.80	.64
Teacher conforms to LST Curriculum	.93	.38
Teacher covers all major points of LST lessons.	.81	.30
Teacher maintains order in the classroom	.41	.81
Teacher uses positive reinforcement	.38	.92
Teacher has class deal with questions posed by students (whenever possible)	.41	.72

Note: Extraction method was Principal Component Analysis; Rotation Method was Oblimin with Kaiser Normalization.

Table 2  
**Correlations and Descriptive Statistics for Implementation Variables**

	1	2	3	4	5	6
<i>Implementation Quantity</i>						
1. Program Points Covered (%)	1.00					
<i>Implementation Quality – Teaching Methods</i>						
2. Lecturing	.14	1.00				
3. Demonstration	.14	-.66	1.00			
4. Discussion	-.17	-.88	.28	1.00		
<i>Implementation Quality – Teacher Qualities</i>						
5. Readiness To Teach	.31	-.68	.64	.47	1.00	
6. Classroom Management Skills	.12	-.41	.63	.07*	.47	1.00
Mean	47.2	40.9	9.9	50.4	3.1	3.2
SD	15.9	15.9	7.7	13.0	1.5	1.6

Note: all correlations significant at  $p < .001$ , except \* $p < .01$

and adopted, it is appropriate for dissemination research on this program to focus on the two latter stages of diffusion: implementation and maintenance. Previous research with LST indicates that implementation fidelity can be highly variable and can be less than desirable for some teachers. For instance, in a study testing the effectiveness of the LST program in 56 New York State schools (Botvin et al., 1990), implementation fidelity scores (or the percentage of LST program points covered by program providers) ranged from 27% to 97% (mean of 68%) based on observations by trained classroom monitors. In more recent work in inner-city schools (Botvin et al., 2001) we found that the average implementation fidelity rate was 48% of program points covered across all program sessions.

Furthermore, in previous studies with the LST, the effectiveness of the program is closely linked to implementation fidelity. Prevention

Table 3  
**Change in Student Smoking and Drinking as a Function of Teacher Qualities Variables**

	Change in Student Substance Use			
	Pretest to Posttest		Pretest to One-Year Follow-Up	
	Smoking	Drinking	Smoking	Drinking
<i>Readiness To Teach</i>	M (SD)	M (SD)	M (SD)	M (SD)
High (Top 20%)	0.03 (0.51) *	0.01 (0.92)	0.11 (0.83) **	0.09 (1.33) *
Other (80%)	0.11 (0.76) *	0.07 (0.92)	0.26 (1.18) **	0.24 (1.24) *
<i>Classroom Management Skills</i>				
High (Top 20%)	0.04 (0.36) *	0.09 (0.98)	0.13 (0.87) *	0.07 (1.36) *
Other (80%)	0.11 (0.81) *	0.04 (0.87)	0.27 (1.23) *	0.25 (1.22) *

Note: \*  $p < .05$ , \*\*  $p < .01$

effects have been strongest among students receiving a more complete implementation of the program. In a long-term follow-up study of LST (Botvin et al., 1995), results in the full sample indicated that the prevalence of heavy drinking and weekly and monthly cigarette smoking was significantly lower for the intervention groups than the control group, and heavy smoking was significantly lower in one of the intervention groups relative to the control group. However, in the high fidelity sample (i.e., those who received 60% or more of the intervention), the results were generally stronger, and more outcomes were significant. The experimental groups were significantly lower than the control group for all measures of cigarette use, weekly alcohol use, drinks per occasion, drunkenness, weekly marijuana use, monthly marijuana use, and monthly alcohol use.

Similar findings regarding implementation fidelity have been observed for other school-based drug abuse prevention programs. A study of 5th grade students in the Los Angeles area found that although 78% of trained teachers implemented one or more program lessons during the first year of programming, only 25% maintained implementation

during the second year; furthermore, integrity of program delivery was positively associated with immediate program outcomes (Rohrbach et al., 1993). In the Midwestern Prevention Project (Pentz et al., 1990), the differences between high and low implementation schools, as measured by amount of implementation or program exposure, was greater than the differences between the treatment and control schools for all measures of substance use. Additionally, the percentage of change in prevalence rates (i.e., proportion of youth using substances) from baseline to one year for cigarette, alcohol, and marijuana use was lowest in the high implementation schools and highest in the low implementation and no implementation schools.

Thus, it has been clearly demonstrated that implementation fidelity is central to program effectiveness. Most research on this issue has focused on the quantitative aspects of program delivery such as level of exposure to the program. The findings from the present study contribute to the literature by illustrating that the more qualitative aspects of program delivery – such as teaching methods used and teacher qualities – play an important role in student outcomes as well. The various quantitative and qualitative components of implementation fidelity were found to be closely interrelated in the present study. Findings indicated that teachers that tend to use lecturing as a teaching method may be able to cover much of the curriculum, but they are less likely to use other more effective teaching methods and are lacking in terms of other important qualities such as readiness to teach. Furthermore, various dimensions of implementation were differentially associated with student substance use outcomes. Generally, the kind of techniques employed by teachers in implementing LST appeared to have had a more significant effect on student outcomes than did the amount of program delivered. Findings indicated that qualitative implementation variables – such as the use of discussion as a teaching method and degree of readiness to teach – were significant predictors of decreased substance use over time. The quantitative implementation score reflecting percentage of program points covered was not a significant predictor of the student outcomes in multivariate analyses. Taken together, these findings support the relevance of process factors in the delivery of LST and similar programs.

Due to the demonstrated importance of implementation fidelity in program effectiveness, the field of prevention must identify the factors that impede high quality implementation and take steps to



break down these barriers. Program developers, implementers, and sponsors must work together to develop strategies to facilitate and enhance implementation. It has been pointed out that a key to bringing evidence-based prevention programs to successful practice settings is "understanding how programs and policies can be implemented so that quality is maintained and the programmatic objectives intended by the program developers are achieved" (Dusenbury et al., 2003). Research has identified a large number of barriers that can interfere with high fidelity implementation and reduce overall program effectiveness. These barriers included a lack of teacher training and program materials, inadequate provision of information regarding the program characteristics and efficacy to the target audience, concerns about the appropriateness of a generic innovation "not invented here," and a lack of trust of scientific findings; institutional factors include decentralized decision making and a lack of program guidance from school district personnel, and a focus on daily management and organizational survival that takes precedence over strategic planning and innovation (Rogers, 1995; Hallfors & Godette, 2002; Backer, 1991; Backer, David, & Soucy, 1995; Domitrovich & Greenberg, 2000).

Factors that promote fidelity include provider factors such as knowledge, skills, training, enthusiasm, self-efficacy, and "ownership" of the intervention; along with environmental or institutional factors such as administrative support from principals and district administrators and experienced staff (Rohrbach et al., 1993; Gold et al., 1991; Pentz & Trebow, 1991; Smith et al., 1995). Other factors found to contribute to successful program implementation include a linkage to stated goals or missions of the school or district and an overall balance of support from new and seasoned administrators (Gager & Elias, 1997). In our own work, we have found that implementation fidelity is improved by having teachers involved in the adoption decision and having a "critical mass" of teachers and other school personnel from each school trained to implement the prevention program.

This study had several strengths and limitations that should be noted. A strength is the use of trained observers to rate implementation fidelity rather than relying on teacher self-reports, which may sometimes reflect a social desirability bias and have little predictive value because of ceiling effects (Lillehoj et al., 2004). Other strengths include the use of a well established data collection protocol that has been refined over several years of school-based research. Limitations include the fact that we

cannot rule out some alternative explanations for our results, including the possibility that teachers with well-behaved students were better able to implement the program more fully and with better quality, and furthermore, that better behaved or lower risk students were more likely to benefit from the intervention. However, a recent study examining the effectiveness of the LST program among youth at high risk for substance use initiation found that it was highly effective with inner-city youth at high social and academic risk (Griffin et al., 2003). Further research on program implementation should study variations in schools, classrooms, and teachers in order to identify the situations where implementation is poorest. Also, it may be useful to conduct qualitative research with teachers who are among the best program implementers in order to identify factors that contribute to success. The ultimate goal of research in this area should be to identify the causes of poor implementation fidelity and develop strategies to address these problems at both the provider and institutional level.

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