Costs, Benefits, and Cost-Effectiveness of Comprehensive Drug Abuse Prevention

Mary Ann Pentz

INTRODUCTION

Several reviews of the literature suggest that prevention programs aimed at counteracting social influences to use drugs show effects on delaying onset rates, and in some cases decreasing prevalence rates, of gateway drug use—tobacco, alcohol, and marijuana use (Botvin and Botvin 1992; Pentz 1993*b*; Tobler 1992). Short-term reductions in monthly use rates have ranged from 20 to 67 percent, based on the calculation of a net program effect as the difference in the rates of increase in use between program and control groups, divided by the control group rate of increase (Pentz 1994*b*). Most of the reductions have been reported for prevention programs that are delivered through a single delivery channel—the school, and a single grade—usually seventh grade, with the number of sessions or contact hours ranging from 3 to 30 (Pentz 1993*b*; Pentz et al. 1990). A few programs have included boosters delivered across multiple grades, such as Life Skills Training, Know Your Body, the Minnesota Youth Smoking Prevention Study, and the health curriculums delivered as part of the School Health Education Evaluation Study (Botvin et al. 1990; Connell et al. 1985; Murray et al. 1989; Walters et al. 1989). These programs, more comprehensive than others in terms of the years and number of sessions delivered, have been associated with longer term, if not larger, reductions lasting up to 5 years, or through the end of high school. A recent review of longitudinal drug abuse prevention studies, however, has indicated no long-term effects of school-based prevention programs after 5 years (Murray 1994). Three longitudinal studies have reported effects after 5 years: the North Karelia Project, the Minnesota Youth Project (part of the Minnesota Heart Health Project), and the Midwestern Prevention Project (MPP) (Murray 1994; Pentz 1993*a*). All three were comprehensive community-based prevention programs that included a school program with boosters and multiple additional components or strategies that were designed to support the school program, including mass media, community organization, and parent involvement. Two of them—the North Karelia and Minnesota Projects—have reported net group differences in smoking prevalence rates that were maintained through or past the last year of high school (6 percent in monthly smoking in the North Karelia study, 8 percent

in weekly smoking in Minnesota), although, since both of these are heart disease prevention studies with a primary focus on adults, effects on other drug use among adolescents have not been reported. One—the MPP—has reported net reductions in daily smoking, drunkenness, and heavy marijuana use among adolescents (Pentz 1993*a*). Adolescent drug abuse prevention is the primary focus of the MPP.

Collectively, results of all of these reviews suggest that the more comprehensive drug abuse prevention programs, operationalized as programs that span several years and include multiple program channels and community support, may yield more long-lasting effects on drug use prevalence than single-year, single-channel programs (Pentz 1993*b*). Because long-lasting effects on use prevalence can be assumed to have more of an effect on deterring health and social costs associated with drug abuse than short-term effects on prevalence or onset (Rice et al. 1990), the costs and benefits of comprehensive prevention programs are the focus of this chapter.

Policymakers, payers, and administrators formulate their decisions about the benefits of drug abuse prevention interventions based on projected healthcare costs of drug abuse, healthcare savings expected from early treatment or prevention, and costs associated with delivery of inter-vention (Rice et al. 1990). Unfortunately, in the field of drug abuse control, under which treatment and prevention fit, costs and savings, or benefits, are often difficult to estimate. There are at least four factors that inhibit valid and reliable estimation of costs and savings or benefits:

- Since most costs are extrapolated from disease states, estimates derived for any substance other than tobacco (for its clear relationship to lung cancer disease) must often be pieced together from a combination of an assumed disease morbidity (e.g., drinking-related liver enlargement assumed to develop into liver cirrhosis) and disease risk behaviors (e.g., drunk driving associated with accidents and injuries).

- The costs of intervention, particularly prevention, vary widely according to length of subject time in intervention, whether costs are partially donated from community resources (e.g., mass media coverage donated as part of a prevention campaign), and type or content of intervention (there is no one definitive treatment or prevention approach that has been shown to be unequivocally more effective than other approaches [Rogers 1992]). The cost issue is compounded for comprehensive prevention programs. Little is known about whether the greater and longer lasting effects shown for comprehensive programs are outweighed by the greater costs incurred with longer programming and a greater number of resources required for delivery of such programs.

- Prevention and early intervention effects and healthcare cost savings often do not appear for several years, during which secular trends, historical events, and an individual's own health development confound effects and costs of intervention (Pentz 1994*b*). Furthermore, effects of prevention programs may not fit a linear trend. For example, a prevention program may show a sleeper effect, i.e., an effect that does not appear until several years after programming. Alternatively, adolescents may progress, regress, terminate, and/or resume stages of drug use and types of drug use over several years for reasons unrelated to prevention programming, for example, because of critical life events, a change in friendship patterns that reflects different peer norms for drug use, or availability of a certain drug.

- The relative costs and benefits of prevention programs and prevention policies are not well understood. The relationship of program to policy also is not understood. For example, if local policy change is supported as a result of an effective prevention program, the policy change should be treated as a program benefit (Casswell et al. 1989; Pentz, in press).

With these limitations in mind, approximate costs, benefits, and cost-effectiveness were calculated from 5-year followup (6-year) outcome data and operational costs of a large, multicommunity-based drug abuse prevention trial, the MPP.

COSTS OF A COMMUNITY-BASED DRUG ABUSE PREVENTION TRIAL

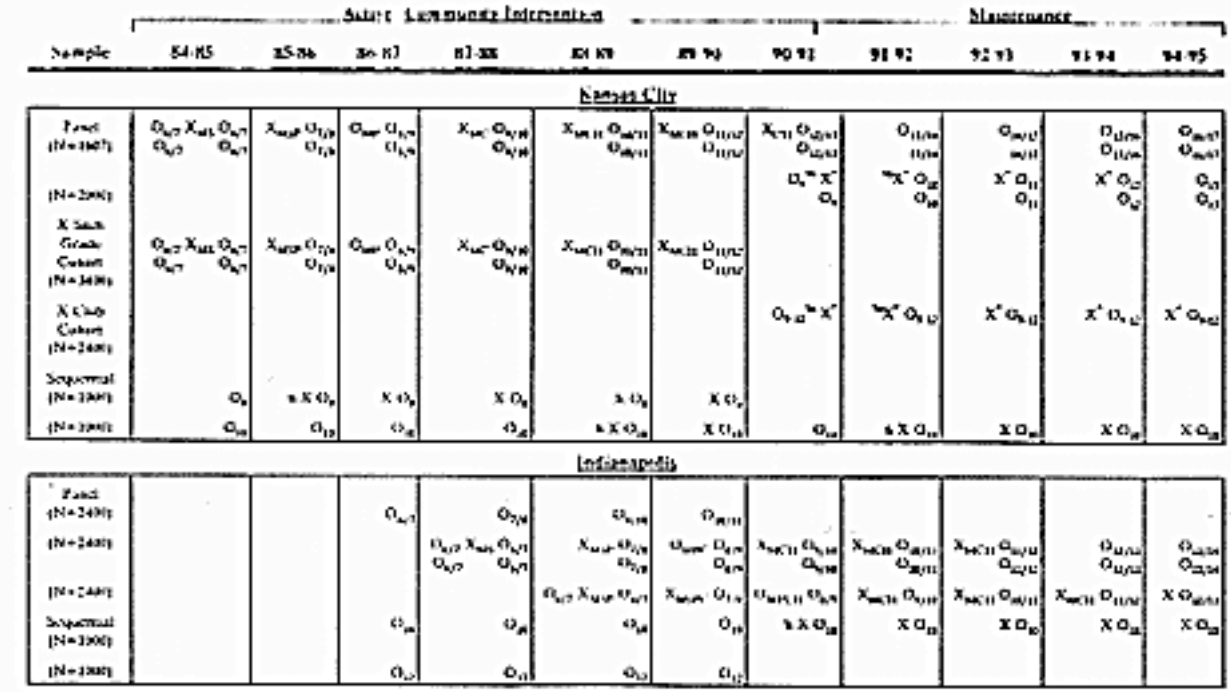
The MPP is a large community-based prevention trial funded by the National Institute on Drug Abuse (NIDA) involving all of the communities (N = 26) and schools (N = 107 middle/junior high schools and N = 62 high schools) that comprise the Kansas City, Kansas; Kansas City, Missouri; and Indianapolis/Marion County metropolitan areas (Pentz et al. 1989*b*). The combined population base is approximately 2.6 million, 75 percent white, 22 percent black, with an average of 26,000 new adolescents exposed to intervention after the first year. The program, research and measurement designs, theory, implementation models, and outcomes are described in detail elsewhere (Pentz 1994*b*; Pentz et al. 1989*b*, 1990). The designs are summarized in table 1 (also see Pentz 1994*b*). Briefly, the intervention consists of five components introduced into schools and communities in sequence at the rate of every 6 months to 1 year: mass-media programming (approximately 31 programs per year for the first 3 years); a school program (an average of 18 sessions over the first 2 years: 13 in sixth/seventh grade, 5 booster sessions in the following year); a parent program (parent education and school policy coordination over years 2 and 3 through the end of middle school); community organization (community leader training, organization, planning, and implementation of

community prevention campaigns, events, services, and planning of policy initiatives in years 3 to 5); and local policy change in years 4 and 5.

In a project of this type and scale—a prevention research trial involving multiple program components—estimation of costs must include program development and research/evaluation (Pentz et al. 1990). Approximate MPP costs per category are shown in table 2. Note that overall, costs in early years are higher than costs in later years because of more extensive program development and that costs per family unit decrease over time as more of the population is exposed to the intervention.

It is assumed that costs of delivering the same program as a "packaged product" for demonstration or service would be less than those shown in table 2 (Bukoski 1990). Of the approximate costs of $7.6 million paid for the MPP (exclusive of donated costs) over the first 6 years, 4.1 or 54 percent were designated for programming and 3.5 or 46 percent for research. Calculated on an average per-year, per-family unit cost with 26,000 new families added per year once both cities were implementing the program in all schools and communities, the paid cost per new family per year is approximately $69, including $37 for programming and $32 for research (Pentz et al. 1990). The cost per family per year is considerably less ($48) when averaged across all families (new and continuing) participating in prevention in any one year. A conservative

TABLE 1. *Abbreviated design of the midwestern prevention project.*



Note: X = intervention, O = measurement, %x = approximately % of the cohort was exposed to intervention, numerical subscript = grade of measurement, alphanumeric subscript = intervention component (M = mass media, S = school, P = parent, C = community organization, H = health policy change), * = new high school environment intervention. (Reprinted with permission from Pentz, M.A., et al. 1990 [b])

TABLE 2. *Approximate direct costs of prevention, by component (in thousands of dollars unless otherwise noted).*

Prevention component	1984-85 Paid (donated)	1985-86 Paid (donated)	1986-87 Paid (donated)	1987-88 Paid (donated)	1988-89 Paid (donated)	1989-90 Paid (donated)
Program development	110 (40)	250	45	180	90	90
Training	25 (19)	50 (38)	50 (68)	75 (87)	100 (76)	100 (76)
Implementation	89 (90)	166 (150)	459 (150)	547 (120)	684 (150)	715 (150)
Institutionalization		22	44	44	66	88
Program subtotal	224 (149)	488 (188)	598 (218)	846 (207)	940 (226)	993 (226)
Research/evaluation	191 (55)	415 (55)	510 (55)	721 (55)	800 (79)	846 (79)
Total (program + research)	415 (353)	903 (243)	1108 (273)	1567 (262)	1740 (305)	1839 (305)
Total (paid + donated)	768	1146	1381	1829	2045	2144
Dollars per family unit						
Total (paid + donated)*	102	51	37	36	34	30

estimate of program development costs is $150,000 per component, in this case, also per year, or $6 per family unit. Thus, one might conclude that a comprehensive community-based program that is delivered as a packaged product to a large city with a population base of over one million would cost about $31 per family unit per year ($37 minus $6). This cost would appear to be very reasonable compared to the cost of a health education textbook alone, which typically exceeds $30.

The costs of delivering a community-based prevention program as a packaged product are misleading, for at least two reasons (Pentz et al. 1990; Rogers 1992). First, an underlying principle of comprehensive social influences prevention programs is dynamism. No program component is a finished product; rather, researchers, community planners, and educators regularly review, refine, and modify components to address changes in the community. Second, an underlying principle of successful adoption, implementation, and maintenance of a program is local ownership. Ownership has a reciprocal relationship with program tailoring. A program that has been tailored specifically to meet the needs of an individual community is more likely to be owned by that community, and thus more readily adopted, implemented, and maintained. Conversely, a community that perceives ownership of a program is more likely to tailor it to its own needs. The two principles of dynamism and ownership represent, further, a tension between two "states" of prevention programming: a product sufficiently stable to represent a reference point, source credibility, and external validity, and yet sufficiently flexible to yield a program that is unique and individual to a particular community and its needs.

With the principles of dynamism and ownership in mind, costs of a packaged product should include some costs for program redevelopment, and some costs for local evaluation that is used to inform redevelopment, if not outcome. Based on local staff estimates from the MPP, program redevelopment costs might be arbitrarily calculated as the cost of one health educator per year, or roughly $45,000 per year; this is approximately 30 percent of new program development costs. Furthermore, based on MPP and Center for Substance Abuse Prevention (CSAP) estimates for community partnership grants, local evaluation costs should constitute approximately 15 to 20 percent of the operating budget, rather than the 46 percent calculated for research in the MPP (see Bukoski 1990).

The costs of developing, mounting, implementing, and maintaining the MPP for the first 6 years in the Kansas City metropolitan area were calculated as $62 per family for the first year and cohort of 26,000, decreasing thereafter as the number of students receiving intervention increases. The costs used here are based on delivery and research to half of the city's student population in the experimental cohort, followed by delivery and evaluation of each entire subsequent cohort; thus, the costs are

considered high and subsequent savings estimates are considered conservative. Calculated in this manner, the cost for delivering and assessing the community prevention program for 6 years in Kansas City alone was approximately $108 per adolescent and the adolescent's family (see Pentz 1994*a*):

Based on a randomly selected subpanel of 1,000:
$108 x 1,000 = $108,000

Based on the experimental group of 7,500:
$108 x 7,500 = $810,000

Based on each subsequent cohort of 15,000 receiving the program:
$108 x 15,000 = $1,620,000

These costs include all research costs, development and piloting costs, and delivery and monitoring of the five program components (mass-media, school, parent, community organization, and health policy change).

In addition to costs associated with the MPP program, costs were also estimated for drug abuse treatment. The major hypothesis underlying the calculation of treatment costs was that the MPP program would, over the long term, prevent drug abuse and thus the need for drug abuse treatment. Costs for drug abuse were based on estimates used by the Kansas City, Missouri, office of the National Council on Alcohol and Drug Abuse (NCADA) for treatment in local area facilities (William Calherka, NCADA, personal communication). These included: $1,500 to $2,000 for outpatient counseling and therapy calculated at an average of 6 weeks duration per client; $10,000 for public inpatient treatment with private treatment ranging up to $15,000 to $20,000 for an average of 30 days duration per client; $5 to $10 per session of student assistance in a college or student health center, based on an average of one session prior to referral to other services; and $150 for a basic alcohol- or drug- related emergency room admission at a local hospital, exclusive of ambulance or treatment costs.

BENEFITS OF THE PROGRAM (EFFECTS)

Some of the effects of the MPP intervention have been reported through 5-year followup (Pentz et al. 1989*b*, 1993*a*, 1994*b*). Cumulative effects of the program components on daily cigarette use, monthly drunkenness, and heavy marijuana use (two or more times per week) are summarized in figure 1 (Pentz 1994*a*). The sample is a random sample of 5,055 students from all 50 public junior high and 29 high schools in the Kansas City area. Note that, as an example, prevalence rates for daily cigarette use in program and control groups are plotted as two lines representing year-to-year changes in the upper left-hand part of the figure. These rates are adjusted for individual school differences in race, socioeconomic status, grade, and

urbanicity; unadjusted rates are similar. When changes in these rates are converted to net group differences as described earlier, the approximate reduction in would-be users from year to year can be estimated (Pentz 1994*b*).

Net group difference = í $[(P_i-P_j)-(C_i-C_j)]$,

Net program effect = í $[(P_i-P_j)-(C_i-C_j)]$/ í(C_i-C_j)],

where

P = program, C = control, i = previous year, j = current year.

The conversion for daily cigarette use is shown in the upper right-hand corner of figure 1; drunkenness and heavy marijuana use (two or more times used in the last week) rates are shown in the bottom of figure 1. The results indicate that the community program components produced an accumulated 5-year net reduction of 12 percent of would-be daily cigarette users, an accumulated 3-year net reduction of 9 percent of would-be monthly drunkenness decreasing to approximately 2.5 percent by 5-year followup, and a 3-year net reduction of 3.5 percent of would-be heavy marijuana users decreasing to approximately 2.5 percent by 5-year followup. The MPP policy change component of the MPP was associated with a 40 percent net reduction in perceived smoking. Effects of the community program components on any monthly and weekly use are larger and have been reported elsewhere (see Pentz et al. 1989*b*).

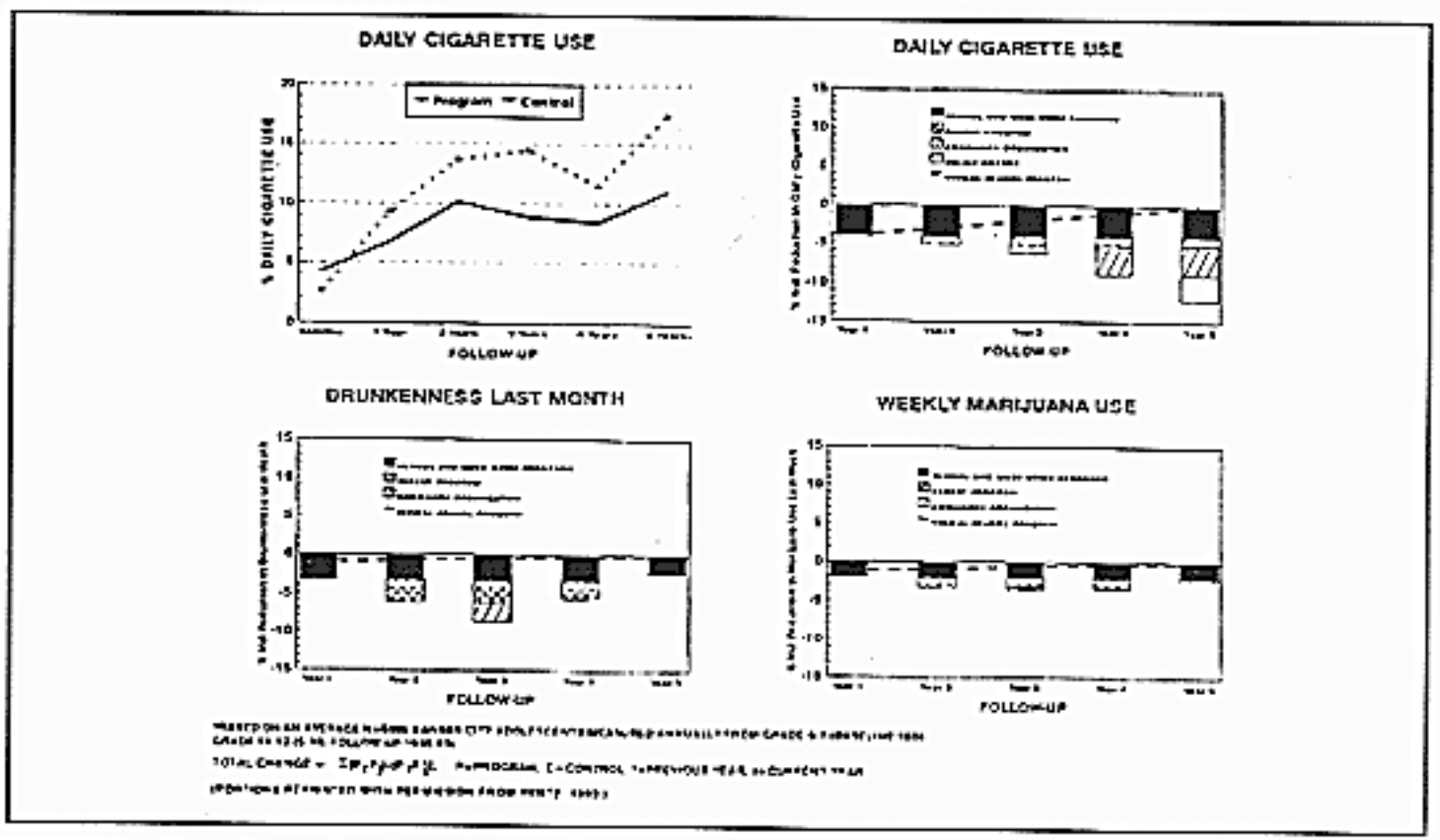


FIGURE 1. *Net reduction from intervention in Kansas City.*

Here rates are shown for heavier or regular use rather than occasional use because of their long-term health and social care cost implications (Oster et al. 1984; Rice et al. 1990, 1992). The net reductions are compared to effects reported for school programs, which disappear 3 to 5 years after programming, as indicated by the dashed line on each graph (Pentz 1993*a*).

Two arbitrary but conservative assumptions are made in reporting the program effects in figure 1. One is that the effect of a particular program component is tied to the year in which the component was introduced into the community. The second assumption is that once an effect associated with the introduction of a particular program component appears, the effect of that component will be maintained relative to the introduction of other components.

Additional recent analyses have focused on the effects of the program on reducing the proportion of adolescents and their family members who must seek professional counseling or treatment for drug abuse. An analysis of a subsample of the original Kansas City cohort that is followed annually through adulthood, a panel of 1,002, indicated that significantly fewer adolescents in the program compared to the control group received professional counseling or treatment by 5-year followup (5.1 percent versus 7.3 percent, $p < 0.04$), and significantly fewer adolescents in the program compared to the control group had family members who received counseling or treatment (18.5 percent versus 22.9 percent, $p < 0.01$). The effects of the program on cigarette, alcohol, and marijuana use in this randomly selected subpanel were the same as those reported for the larger sample above.

The benefits can be estimated as follows (Oster et al. 1984): For changes in use prevalence rates, total health and social care cost savings are limited to estimates per prevented daily smoker, exclusive of use of other substances. The savings were previously calculated as $40,000-plus per prevented male smoker and $17,000-plus per prevented female smoker, for an average savings of $28,000-plus (savings are averaged since there is no evidence for differential effects of the program on males versus females).

Based on the subpanel of 1,002:
120 prevented smokers x 28,000 = $3,360,000

Based on the experimental group of 7,500:
900 prevented smokers x 28,000 = $25,200,000

Based on each subsequent cohort of 15,000:
1,800 prevented smokers x 28,000 = $50,400,000.

For treatment savings, based on a conservative estimate using outpatient counseling and treatment costs only, the savings are:

Based on the subpanel of 1,002:
22 prevented treatment x $2,000 = $44,000

Based on the experimental group of 7,500:
165 prevented treatment x $2,000 = $330,000

Based on each subsequent cohort of 15,000:
330 prevented treatment x $2,000 = $660,000.

For treatment savings from family members, the savings are:

Based on the subpanel of 1,002:
44 prevented treatment x $2,000 = $88,000

Based on the experimental group of 7,500:
330 prevented treatment x $2,000 = $660,000

Based on each subsequent cohort of 15,000:
660 prevented treatment x $2,000 = $1,320,000.

If treatment savings are added across self plus family members, the savings are $132,000; $990,000; and $1,980,000, respectively. The benefits of the MPP are summarized in table 3.

COST BENEFIT OF PREVENTION

For policymakers, the benefits of comprehensive community-based drug abuse prevention must be compared to its costs. The major question in cost-benefit calculations is: "Is prevention worth it?" A summary of cost-benefit for the MPP is shown in table 3.

TABLE 3. *Benefits, cost-benefits, and cost-effectiveness of prevention by 1989-90.*

Benefit category	Benefit (% reduction x cost saving per family) in thousands of dollars	Cost-benefit for every $1 spent on prevention: saved in dollars	Cost-benefit per affected family in dollars	Cost-effectiveness (ratio of incremental cost of MPP compared to alternative drug education: incremental effectiveness) in % net reduction
Net reduction in daily smoking	3360.00	$1:8.12	$1:67.63	$1:.48
Net reduction in monthly drunkenness	700.00	$1:1.69	$1:67.63	$1:.10
Net reduction in heavy marijuana use	700.00	$1:1.69	$1:67.63	$1:.10
Net reduction in need for treatment				
- Outpatient treatment	4.40	$1:.11	$1:4.83	$1:.09
- Inpatient treatment	3.00	$1:.80	$1:36.23	$1:.09
- Counseling center	.22	$1:.00	$1:1.02	$1:.09
- Emergency room admission	3.30	$1:.01	$1:1.36	$1:.09
Net reduction in family member need for treatment	.88	$1:.21	$1:4.83	$1:.18
- Outpatient treatment	6.60	$1:1.59	$1:36.23	$1:.18
- Inpatient treatment	.44	$1:.00	$1:.02	$1:.18
- Counseling center				
- Emergency room admission	6.60	$1:.02	$1:.36	$1:.18
Net reduction in perceived smoking at school related to school policy	896.00	$1:2.16	1:67.63	$1:1.6

NOTE: Costs and benefits are based on 26,000 new families added per year to the prevention program.

The costs and benefits of community-based prevention can be compared as a ratio of costs of the program: benefits derived from reduced prevalence rates of daily smoking and reduced proportions of the population in drug treatment. The cost-benefit ratio in table 3 is calculated twice: once assuming that all families must participate in order for prevention effects to appear, and again assuming that only affected families (would-be users) must participate. For daily smoking, the ratio is 1:67.63, or $1 expended for prevention programming for $67.63 per affected family in health and social care cost savings from prevented smoking. For treatment through 5-year followup (6 years), exclusive of any future treatment, the ratio is 1:4.83, or $1 expended for prevention programming for $4.83 per affected family saved in outpatient counseling or similar treatment up through the first 5-year followup. Note that this saving would be much higher if inpatient costs were used in lieu of outpatient costs, and if treatment savings were extrapolated into adulthood, as are estimates of prevented smoker cost savings.

COST-EFFECTIVENESS OF PREVENTION

For policymakers and program administrators, the decision to adopt a comprehensive community-based drug abuse prevention program depends on its costs and benefits relative to the costs and benefits of existing, readily available, and/or alternative prevention programs or services (Hurley 1990). The major question implied in cost-effectiveness calculations is: "Is this type of prevention worth the time, trouble, and costs relative to other alternatives?" For the MPP, cost-effectiveness should be based on comparing the relative effects or benefits of the community program with another type of educational or prevention program. A recent report to the U.S. Congress estimated school-based drug education costs at between $2 and $6 per student per year, exclusive of textbooks (see Bukoski 1990; MMWR 1989). Relatively little is known about the benefits of traditional drug education delivered in health education as usual curriculums, other than knowledge change (Goodstadt 1989). However, in the case of the MPP, since all students in the control group received health and drug education "as usual" in schools, in one sense, the cost-benefit could be considered a cost-effectiveness analysis. Cost-effectiveness of the MPP is summarized in table 3, using an estimate of $6 per student per year to deliver drug education, with essentially zero effects accrued on use, compared to $31 per family per year to deliver a packaged product, with 12 percent (daily cigarette use), 2.5 percent (monthly drunkenness), and 2.5 percent (marijuana use *Æ* two times in last week) reductions accrued by 5-year followup. The cost-effectiveness ratio of the MPP relative to school drug education is equal to the ratio of the incremental costs of the MPP to its incremental effectiveness.

COST-UTILITY OF PREVENTION

Cost-utility is similar to cost-effectiveness, except that benefits are expanded to include outcomes that are immediately measurable, for example, whether a comprehensive prevention program is readily adopted, well-liked by deliverers and consumers, fits easily with other existing services, and potentially benefits other services (Booth 1990; Hurley 1990). The implied questions of interest are whether the program is used and is user friendly. Although no systematic evaluations are available on the relative user friendliness of comprehensive community-based prevention programs relative to other types of programs, the general response of communities to research-based prevention programs is that they are not as readily adopted or institutionalized as school-mandated health curriculums, commercially marketed programs (e.g., Here's Looking At You), grassroots-prompted programs (e.g., MADD), or agency-endorsed programs (e.g., QUEST and DARE) (Pentz et al. 1990; Rogers 1992). More research is needed to operationalize and evaluate the utility of various prevention program alternatives.

CONCLUSION

The costs and savings estimated here were based on conservative formulas such that the costs of the program were deliberately inflated and savings were underestimated. Even so, the results presented here indicate that comprehensive drug abuse prevention programs, such as a multicomponent community-based prevention program, are highly cost-beneficial and cost-effective. Future research should focus on developing methods for estimating valid and reliable costs and savings associated with drugs other than tobacco and alcohol. In addition, more research is needed to estimate benefits of traditional health and drug education in terms of changes in drug use behavior for cost-effectiveness analyses. For cost-utility calculations, research is needed to identify appropriate indicators of prevention utility, and then to evaluate utility of prevention relative to other alternatives (Hetherington and Calderone 1985).

Identifying costs and benefits of prevention for various analyses is not the only issue. The analysis methods and databases routinely used in econometrics analyses have not readily transferred to prevention researchers. For example, prevention researchers rarely use discounting methods for cost calculations, or relative risk ratios or Markov models to estimate different outcomes of prevention intervention (Hurley 1990; Oster et al. 1984; Rice et al. 1990, 1992). The estimates in this chapter are not discounted, raising the possibility that benefits are inflated if the discounted rate were the same for costs of prevention and later treatment and morbidity costs. Further inflation may have occurred due to benefits in this chapter calculated on a relative net reduction in the dependent variable, rather than absolute values. Furthermore, the archival databases that yield morbidity and mortality data for econometricians are rarely used by prevention researchers, with the exception of estimating effects of policy changes.

Finally, relatively little is known about the costs and benefits associated with local policy change and its relationship to comprehensive drug abuse prevention (Pentz, in press; Pentz et al. 1989*a*). It is generally assumed, for example, that enacting a restrictive community smoking policy should be far less costly than a smoking or drug abuse prevention program, with greater benefits since an entire population is supposedly affected (Goodstadt 1989). However, labor and other costs involved in developing and promoting policy change are typically not considered, and benefits will be directly related to policy compliance. In the MPP, recent preliminary analyses of policy changes in schools showed that schools assigned to the intervention condition adopted more restrictive smoking policies (96 percent versus 88 percent) and had less observed student smoking than schools assigned to the control condition (48 percent versus 88 percent). These results suggest that policy change may be an additional benefit of comprehensive community-based prevention programs rather than an alternative prevention strategy (Bracht 1990). More research is needed to elucidate the temporal, if not causal, relationship of community-based prevention programs and local policy change.

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AUTHOR

Mary Ann Pentz, Ph.D.
Department of Preventive Medicine
Institute for Health Promotion and
Disease Prevention Research
School of Medicine
University of Southern California
1540 Alcazar, Suite 207
Los Angeles, CA 90033

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