Economic Analysis of Methamphetamine Prevention Effects and Employer Costs*

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ABSTRACT. Objective: The goal of this research was to evaluate economically three interventions designed to prevent substance use in general populations of adolescents, specifically focusing on the prevention of methamphetamine use and its subsequent benefits to employers. **Method:** In a randomized, controlled trial, three preventive interventions were delivered to 6th- or 7th-grade youth in 58 Iowa school districts, with 905 of these youth (449 girls) providing follow-up assessments as 12th graders. Intervention conditions included the family-focused Iowa Strengthening Families Program (ISFP), the school-based Life Skills Training (LST) program, and a combined condition of both the Strengthening Families Program: For Parents and Youth 10–14 (SFP10–14; an ISFP revision) plus LST (LST + SFP10–14). Analyses based on intervention costs, 12th-grade methamphetamine use rates, and methamphetamine-related employer costs yielded estimates of intervention cost, cost-effectiveness, benefit–cost ratio, and net benefit. **Results:** The ISFP lowered methamphetamine use by 3.9%, cost $25,385 to prevent each case, and had a benefit–cost ratio of 3.84, yielding a net benefit of $2,813 per youth. The LST program reduced methamphetamine use by 2.5%, required $5,122 per prevented case, and had a benefit–cost ratio of 19.04, netting $2,273 per youth. The combined LST + SFP10–14 prevention condition lowered methamphetamine use rates by 1.8%, cost $62,697 to prevent each case, had a benefit–cost ratio of 1.56, and netted $620 per youth. Findings were robust after varying a number of key parameters across a range of plausible values. **Conclusions:** Substance use prevention programming is economically feasible, particularly for effective interventions that have lower per person treatment delivery costs. (*J. Stud. Alcohol Drugs, 72,* 577–585, 2011)

ECONOMIC ANALYSIS IS AN IMPORTANT TOOL for evaluating program efficiency and assisting in decision making regarding program implementation and sustainability (Foster et al., 2003). The quantification of program costs, benefits, and outcomes is valuable for communicating effectiveness in monetary terms, thereby providing a common language for researchers and funders (Aos et al., 2004, 2006; Jones et al., 2008). Economic analyses are especially useful for researchers seeking to quantify and describe the often substantial monetary savings of prevention over tertiary care (Drummond et al., 2005; Haddix et al., 2003). Despite the utility of these analyses, economic research that is focused on intervention evaluation remains limited (O'Connell et al., 2009).

Empirical evaluation of preventive interventions designed to reduce substance use rates has demonstrated not only the effectiveness of prevention efforts but also the consequent savings to a variety of stakeholders (Aos et al., 2004). Economic evaluations have largely focused on legal substances such as nicotine or alcohol (Spoth et al., 2002a; Wang et al., 2001) but have neglected methamphetamine use. Methamphetamine, a central nervous system stimulant, is a highly addictive Schedule II drug that is often made in illegal laboratories (O'Dea et al., 1997; Volkow et al., 2001). Although methamphetamine prevalence rates in the United States remain lower than that of many other drugs (i.e., 4.6% lifetime use and 0.6% annual use; Substance Abuse and Mental Health Services Administration, 2007), a majority of state law enforcement agencies report methamphetamine as their primary drug problem (National Association of Counties, 2005). Further, the proportion of justice system–referred methamphetamine-related treatment admissions is approximately 50% higher than for any other illicit substance (Substance Abuse and Mental Health Services Administration, 2007). This incongruity is related to the severe effects methamphetamine use has on health and functioning.

Economic feasibility of methamphetamine prevention

Recently published results from longitudinal randomized intervention-control prevention trials indicate that several programs designed for general populations of adolescents and families that aim to reduce substance use, delinquency, and other problem behaviors are effective at reducing methamphetamine use rates at the threshold of adulthood (Spoth et al., 2006). Such effectiveness constitutes a necessary—but not sufficient—condition for economic feasibility. As a group, these programs target factors that favorably affect youth and family functioning, including youth attitudes, decision making, and interpersonal skills, as well as parenting, intrafamily

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communication, and quality of the parent–child relationship. Thus, the interventions target a variety of risk factors and seek to promote a number of protective processes.

The developmental timing of these interventions is of paramount importance (Catalano and Hawkins, 1996). They are delivered early in adolescence when substance use experimentation rates increase but before enduring patterns of use become established and anti–substance use messages are not yet antithetical to the self-concept. The intent of the interventions is to promote bonding to prosocial adults and peers and reduce the likelihood of pursuing a path of antisocial relationships and behaviors. In this manner, these interventions cause youth to delay or entirely abstain from substance use during the critical developmental period of adolescence. This has implications for adult substance use in general—and methamphetamine use in particular—insomuch as early initiation can be associated with worse outcomes in late adolescence and adulthood, as has been reported for alcohol use disorders (Grant and Dawson, 1997).

In addition to the effectiveness of the intervention, other factors affect the economic feasibility of prevention. Specifically, the more prevalent a condition is, and the more cost it entails, the greater the savings generated by prevention. National survey data reveal past-year methamphetamine use (PYMU) rates of 0.6% in 2006 (Substance Abuse and Mental Health Services Administration, 2007). Although this level of occurrence does not rival that of nicotine dependence, alcohol use disorders, or marijuana use, it does constitute a significant portion of the population when one considers the potential severity of methamphetamine use. Methamphetamine use is associated with negative consequences across a range of domains, including poor health, criminal behavior, damaged social relationships, adverse employment outcomes, and the risk of dependence (Nicosia et al., 2009). These outcomes produce costs in the form of both resources expended to address these problems and resources forgone because methamphetamine users are less productive. In other words, because of the potential severity and breadth of its impact on an individual, methamphetamine use may generate greater costs than other substances at comparable rates of use and may increase the likelihood that methamphetamine use prevention will be economically advantageous.

Overview of the current analysis

The current study presents an economic analysis of three preventive interventions designed for general populations of adolescents and targeted to delay or prevent the onset of early adolescent substance use and other delinquent behaviors. In addition to providing data regarding the cost of program delivery, cost-effectiveness estimates were calculated to indicate the cost (in U.S. dollars) to achieve a single unit of prevention, which in this analysis corresponds to preventing one adolescent from using methamphetamine in the past year. In addition, the benefit–cost ratios and net benefits per youth for these interventions were estimated from the dollar cost savings to employers that are generated from the methamphetamine prevention effect produced, relative to dollars spent in delivering each intervention. Finally, sensitivity analyses examined the effect of varying key variables.

Analytical perspective

Benefits in the current analysis were calculated from the perspective of employers using the human capital approach (Johannesson, 1996). In the human capital approach, benefits are limited to the market value of increased productivity associated with the effects of preventing methamphetamine use, which in this study entailed decreased absenteeism, health care costs, theft, turnover, and increased productivity on the job. The human capital approach is well suited for calculating employers' valuation of prevention because it estimates how prevention-related changes in employee behavior would affect revenue.

Consideration of benefits from the perspective of employers is important for several reasons. In developed countries, a large portion of economic activity is associated with human productivity, which can be quantified by employment compensation. Indeed, the sum of individual productivities is strongly related to major indices of economic strength, such as gross domestic product, indicating the national interest in widespread implementation of prevention efforts that increase worker productivity. Also, increasing productivity has beneficial effects across all of society, including increased government revenues from personal income and employer profits. Further, the business community is an influential constituent group. Demonstrating how prevention can work to their advantage would be helpful in gaining policy makers' support for large-scale prevention efforts.

Method

Participants

The current analysis was based on outcomes from two randomized intervention-control prevention trials conducted in 58 Iowa school districts. School districts were targeted for recruitment based on community size and lunch program eligibility rates, and families within those school districts were invited to participate. All research connected with the current investigation was reviewed and approved by the Institutional Review Board Committee in the Office for Responsible Research at Iowa State University. In the portion of Study 1 pertinent to this analysis, 446 youth completed pretesting in 6th grade; of these, 308 completed the 12th-grade assessment that included the measure of methamphetamine use and, thus, were available for inclusion in analyses. In Study 2, 679 youth completed 7th-grade pretesting; of these, 597

completed the 12th-grade assessment. Retention across these studies averaged 80.4%, which compares favorably to rates reported from a review of similar longitudinal substance use–disorder prevention studies (Hansen et al., 1990). For Studies 1 and 2, pretesting took place in 1993 and 1998, at which time families' median household income was $34,000 and $43,000, there were 3.1 and 3.2 children per family, 52% and 46% of target children were girls, average ages of mothers were 37.2 and 39.0 years, and average ages of fathers were 39.4 and 41.4, respectively. Representative of the study region, large majorities of families described themselves as dual parent (86% and 87%) and White (98% and 99%), with both mothers and fathers having completed high school (95% and 96%), for Studies 1 and 2, respectively.

Design and interventions

Schools in each study were grouped based on several variables, such as community size and income, and then randomly assigned to either an intervention or a minimal contact control condition, with randomization not revealed until after recruitment and pretesting. The intervention conditions for Study 1 were the Iowa Strengthening Families Program (ISFP) and Preparing for the Drug Free Years, and for Study 2 they were the Life Skills Training (LST) program (LST only) and a condition that included both LST and the Strengthening Families Program: For Parents and Youth 10–14 (LST + SFP10–14). Methamphetamine use was not reduced in the Preparing for the Drug Free Years condition of Study 1, rendering economic analysis of its effects illogical. For this reason, no data or results of that condition are included in this article or further discussed. The seven-session, family-based ISFP included both parents and their young adolescent child and focused on parenting skills, parent–child relationships, and adolescent skills. The LST intervention is a 15-session, school-based intervention including adolescents only and concentrating on youth attitudes, norms, information, and substance use resistance and refusal skills. The SFP10–14 is an adaptation of ISFP and, likewise, is a seven-session, family-focused intervention in which both parents and youth participate with the same focus areas as ISFP. Greater detail regarding the content and delivery of these interventions is available in previously published reports (for ISFP, Spoth et al., 1998; for LST and SFP10–14, Spoth et al., 2002b).

Procedure

In both studies, research staff visited the recruited families in their homes to conduct periodic assessments. These assessments began with a household composition interview, after which time family members completed written questionnaires confidentially in separate rooms of the residence. Families also participated in structured interaction tasks that were videotaped. The total assessment visit required approximately 2.5 hours, for which participants were initially compensated at the rate of $10 per hour, with small increases at each successive wave of data collection.

For Study 1, pretesting occurred when target children were in the fall semester of 6th grade, with posttests occurring approximately 6 months later during the spring semester. The next four follow-up assessments took place when children were in the spring semesters of 7th, 8th, 10th, and 12th grade, occurring 18, 30, 54, and 78 months after pretesting. In Study 2, pretesting occurred in the fall semester of the 7th grade, with posttests occurring approximately 6 months later during the spring semester. The next four follow-up assessments took place when children were in the spring semesters of 8th, 9th, 11th, and 12th grade, occurring 18, 30, 54, and 66 months after pretesting.

Estimation of program costs and effects

Implementation costs and effects are calculated in such a way as to make them conservative estimates of what would be expected were the programs delivered through a large-scale public health initiative. Cost per participant was calculated by dividing the total program cost by the number of participants who received the intervention, without assuming cost reductions as a result of improved cost efficiency that would be expected if the programs were repeatedly implemented, or their scale increased. Intervention effects are calculated using an intent-to-treat approach and are based on available data from all youth targeted for intervention and not just those who actually participate. Thus, this approach is conservative because it estimates program effects among all targeted individuals and not only among those who actually participated in the intervention. Methamphetamine prevention is measured as 12th-grade PYMU rate in the control condition minus each intervention condition's PYMU rate.

Dollar benefit of prevention to employers

The dollar benefit to employers associated with preventing methamphetamine use was estimated following a two-step procedure. First, the association between PYMU and behaviors relevant to the employment outcomes of absenteeism, health care costs, theft, decreased productivity, and turnover were calculated. These associations were calculated from data provided by the U.S. Department of Health and Human Services (2009) that include results from the National Survey on Drug Use and Health (NSDUH), a large-sample (N = 67,802 in 2006), nationwide survey of individuals selected by a multilevel stratified design with random selection to provide a representative sample of the entire nation. The NSDUH focuses on the assessment of a broad range of substance-related behaviors and outcomes, including a number associated with employment. The predictive relation-

ship between methamphetamine use and each employment-relevant behavioral outcome variable (e.g., absenteeism) was estimated as the average methamphetamine coefficient from six multilevel regression analyses conducted using SAS 9.1 (SAS Institute Inc., Cary, NC) PROC SURVEYREG, with each analysis being performed on one of the six independent data sets provided by the annual NSDUH from 2001 through 2006. Second, to determine employer costs stemming from each employment-relevant behavioral outcome, we used data available from (a) the Bureau of Labor Statistics (BLS) for absenteeism, health care use, and productivity; (b) the Association of Certified Fraud Examiners for theft; and (c) surveys of personnel professionals for turnover costs. For absenteeism, employer cost is the revenue forgone by not having an employee show up at work. The marginal revenue product of labor provides a lower-bound estimate of employer revenue lost through absenteeism and may be conservatively estimated as the total employee compensation that would have been earned during the absent period (Pauly et al., 2002). The additional annual hours of methamphetamine-related absenteeism estimated from the NSDUH data were multiplied by the BLS hourly compensation data (adjusted for age and the lower compensation received by methamphetamine users, as detailed below) to yield, for each year of age, employer methamphetamine-related absenteeism costs per year per methamphetamine user.

For health care costs, we used BLS data to calculate the average employer cost per employee associated with providing health care benefits and then estimated the additional cost for methamphetamine users, presuming their greater use was proportional to their greater reporting of days absent because of sickness, as indicated by the NSDUH data. Costs resulting from decreased productivity correspond to employers paying methamphetamine users for one level of productivity but receiving a lower level of productivity. Making use of the assumptions that the marginal revenue product of labor conservatively estimates employer revenue and that the labor market will, in the long run, pay workers according to their relative productivity, we approximated methamphetamine users' relative productivity as the proportion of compensation received by methamphetamine-using employees to the compensation received by nonusing employees as observed at age 28, corresponding to 10 years after entering the adult labor market. This proportion equaled 76%, the average ratio of methamphetamine users' to nonusers' income at age 28 across the six NSDUH surveys. This proportion was multiplied by BLS 2006 data for the average employee total compensation at each year of age to estimate methamphetamine users' lower average productivity, which was subsequently used to calculate how much employers overpay methamphetamine-using employees at a particular year of age by comparing it with methamphetamine users' average compensation at that age. For example, at a given year of age, if the average nonusing employee were paid $\$x$ per hour and the average methamphetamine-using employee were paid 95% of what a nonusing employee is paid at that same year of age, then the dollar amount per hour the methamphetamine-using employee is overpaid within that year equals $(.95)\$x - (.76)\$x = (.19)\$x$ per hour.

With regard to theft, we used the monetary value of total employer losses because of employee theft as reported by the Association of Certified Fraud Examiners (2006) in combination with the differential arrest rates for larceny among methamphetamine users from NSDUH data to estimate the disproportionate share of total employee theft associated with methamphetamine use. The relationship between methamphetamine use and turnover was estimated by the difference between methamphetamine users and nonusers regarding the number of employers they had worked for in the past year, as reported in the NSDUH data. The difference was multiplied by the average yearly wage of a methamphetamine user and by a factor of 1.5, the latter of which links employers' turnover costs to employee pay (Griffeth and Hom, 2001).

Additional adjustments to employer costs

In the above calculations, a number of adjustments were made where appropriate. For example, several employer costs depend on the compensation the employee receives. Employee compensation changes with age, tending to increase throughout the early years in the labor market and then level off in later years. Therefore, employer costs were computed for employees at each year of age using BLS 2006 estimates. In addition, as indicated above, the productivity of methamphetamine-using employees is estimated at 76% of nonusing employees, as indicated by lower levels of compensation for the former. Therefore, employer costs were reduced for absenteeism and turnover to account for the fact that methamphetamine users are less productive and thus cause less revenue loss when they are absent or must be replaced. In addition, employer benefits are distributed across the future working career of an individual, taken to be from ages 18 to 65. At any particular year in an individual's working career, the amount of monetary benefit resulting from methamphetamine use prevention in that individual will depend on the likelihood of a methamphetamine user being employed, the likelihood of an employee engaging in methamphetamine use, and employee productivity—all of which vary with age. For these reasons, the employer costs described above are calculated for each year of age, accounting for changes in these variables from ages 18 to 65. In particular, the six NSDUH surveys were used to determine age-related changes in methamphetamine use and the relative likelihood of employment for methamphetamine users, whereas BLS data were used to estimate the relationships of age to both employment rates and productivity.

Accounting for the above factors yielded estimates of em-

ployer costs associated with each case of methamphetamine use for each year of age throughout the employment career. These annual employer costs were discounted at 3% per year from the year of age in which they are estimated to occur back to the age of 12 years, the approximate age of the youth when intervention costs were incurred, to yield a single net present value of prevention of each methamphetamine use case, which equaled $97,532 in 2006 dollars.

Results

Sample quality: Representativeness of the sample, pretest equivalence, and attrition

Earlier reports provided detailed descriptions of tests conducted to establish sample representativeness and pretest equivalence, as well as to rule out differential attrition (Spoth et al., 1997, 1998). To summarize these findings, no significant Condition × Attrition interaction effects were found for any sociodemographic or substance use variables between the pretest and 12th-grade follow-ups. Although there was some evidence of increased attrition among alcohol-using adolescents in Study 1 (Spoth et al., 2001), attrition rates did not differ across conditions. Because there was no methamphetamine-specific measure at pretest for either study, a proxy measure—marijuana use in the past year—was used to examine differential attrition. In later assessments, this particular substance use measure was significantly and strongly correlated to methamphetamine use in the past year. Pretest equivalence was found for this proxy measure, and there was no evidence of differential attrition related to past-year marijuana use.

Intervention effectiveness

PYMU rates were used to calculate the intervention effectiveness by subtracting the intervention condition rates from the control condition rate to estimate the number of instances of PYMU prevented per youth. As reported in a previous publication (Spoth et al., 2006), ISFP, LST only, and LST + SFP10–14 PYMU rates were 0% (90% CI [0%, 1.65%]), 1.44% (90% CI [0.43%, 3.81%]), and 2.12% (90% CI [0.75%, 5.06%]), respectively. By comparison, the average control condition PYMU rate was 3.90%. These findings indicate rate differences of 3.90%, 2.46%, and 1.78% for ISFP, LST only, and LST + SFP10–14, respectively. Expressed as decimals rather than percentages, these numbers correspond to the average number of PYMU cases prevented per youth in each intervention condition.

Intervention cost

All costs were converted into 2006 U.S. dollar equivalents because 2006 was the last year for which complete archival data were available. The cost to deliver ISFP to the 117 families in the current study has been previously reported by Spoth et al. (2002a) as $85,136 in 1994. After adjusting for inflation, this amount corresponds to $115,813 in 2006, or $990 per adolescent. Intervention costs for LST were calculated from those observed in the current study, including costs associated with training, materials, and opportunity time costs for teachers in both training and intervention delivery, to yield a cost of $126 per adolescent. The LST intervention included boosters implemented 1 year after implementation of the core program content. Accordingly, these later costs were discounted at 3% and are included in the cost cited. The per-adolescent cost for SFP10–14 was estimated to be $990, the same as that for ISFP, because of the similarity in training, format, sessions, and facilitation. Thus, the cost for the combined LST + SFP10–14 condition was computed by adding the cost for LST only to the SFP10–14 cost, for a total cost of $1,116 per adolescent. No cost savings were assumed for the combined condition because the materials, training, and implementation of the two programs were separate, with SFP10–14 delivered to families in the community during evenings and weekends, and LST delivered to public school students during classroom hours.

Cost-effectiveness

Incremental cost-effectiveness ratios (ICERs) are constructed to determine the cost per PYMU case prevented (Haddix et al., 2003). ICERs are calculated as the intervention cost per person divided by the number of PYMU cases prevented per person, the latter of which equals the rate difference between the control and intervention conditions. Using values provided above regarding intervention cost and intervention effectiveness, the ICERs are as follows: $990 / .0390 = $25,385 for ISFP, $126 / .0246 = $5,122 for LST only, and $1116 / .0178 = $62,697 for the combined LST + SFP10–14. These cost-effectiveness figures correspond to the cost per PYMU case prevented among 12th-grade students.

Benefit–cost ratio

The monetary benefit of preventing a single case of PYMU was estimated by assuming that the relative risk reduction for PYMU would be matched by a proportional reduction of employees using methamphetamine in the past year. The prevention of each PYMU case related to a reduction in use rates that predicted a corresponding reduction in employer costs across the working career (i.e., ages 18–65) of an employee totaling $97,523 in net present value at the time of initial intervention implementation at age 12. The benefit–cost ratios were thus calculated by dividing the benefit resulting from each unit of prevention by the cost to achieve each unit of prevention, or the ICER. Benefit–cost ratio calculations were as follows: for ISFP

($97,523/$25,385) = $3.84 benefit per $1 cost; for LST only ($97,523/$5,122) = $19.04 benefit per $1 cost; and for LST + SFP10–14 ($97,523/$62,697) = $1.56 benefit per $1 cost.

Net benefit

The net benefits per youth were calculated by multiplying the number of PYMU cases prevented per adolescent by the dollar benefit per case prevented and subtracting from this product the cost to intervene with each adolescent. The net benefit was (.0390 × $97,523 − $990) = $2,813 for ISFP, (.0246 × $97,523 − $126) = $2,273 for LST only, and (.0178 × $97,523 − $1,116) = $620 for LST + SFP10–14.

Sensitivity analyses

To examine the robustness of the results, the benefit–cost figures were recalculated a number of times after varying key estimates and assumptions included in the determination of the reference case. In particular, Table 1 presents the effects on the benefit–cost ratio and net benefit of varying from the reference case values used for intervention effectiveness, intervention cost, the benefit associated with the prevention effect, the decay of intervention effects across time, and variations in the discount rate. For the most part, results of the sensitivity analysis indicated that the ISFP, LST only, and combined LST + SFP10–14 interventions maintained their economic feasibility with benefit–cost ratios exceeding 1 and net benefits greater than 0. The LST only intervention performed particularly well, owing to a combination of both efficacy and low cost per treated adolescent. The more costly LST + SFP10–14 combined condition did lose its economic advantage under some unfavorable assumptions, such as under higher discount rates or when the prevention effect was presumed to decrease with time.

Supplemental analysis: College graduation

Insomuch as the foregoing results rest on long-term projections of methamphetamine use, we also evaluated a comparatively proximal effect of methamphetamine prevention that has implications for employment, namely college

Table 1. Sensitivity analysis of benefit–cost ratios and net benefits for three preventive intervention conditions' effects on employer costs

	ISFP		LST only		LST + SFP10–14	
Variable	B/C	Net ben.	B/C	Net ben.	B/C	Net ben.
Reference case[a]	$3.84	$2,814	$19.04	$2,273	$1.56	$620
Intervention PYMU rate[b]						
0%	$3.84	$2,814	$30.19	$3,678	$3.41	$2,688
1%	$2.86	$1,838	$22.45	$2,702	$2.53	$1,712
2%	$1.87	$863	$14.71	$1,727	$1.66	$737
3%	$0.89	($112)	$6.97	$752	$0.79	($238)
Lower 90% CI	$3.84	$2,814	$26.84	$3,256	$2.76	$1,961
Upper 90% CI	$2.22	$1,204	$0.67	($42)	–[c]	–[c]
Intervention cost[d]						
+10%	$3.49	$2,715	$17.31	$2,261	$1.41	$508
–10%	$4.27	$2,913	$21.16	$2,286	$1.73	$732
Prevention benefit[e]						
+10%	$4.23	$3,194	$20.95	$2,513	$1.71	$794
–10%	$3.46	$2,433	$17.14	$2,033	$1.40	$446
Decreasing prevention effect over time[f]						
5 years	$0.49	($510)	$2.40	$177	$0.20	($897)
10 years	$1.02	$25	$5.08	$514	$0.41	($653)
20 years	$1.75	$741	$8.67	$966	$0.71	($326)
Discount rate[g]						
3%	$3.84	$2,814	$19.04	$2,273	$1.56	$620
4%	$3.20	$2,176	$15.85	$1,871	$1.29	$329
5%	$2.69	$1,670	$13.32	$1,552	$1.09	$98
6%	$2.28	$1,265	$11.29	$1,296	$0.92	($87)
7%	$1.95	$937	$9.65	$1,089	$0.79	($237)
8%	$1.67	$668	$8.30	$920	$0.68	($359)

Notes: Net benefit values in parentheses represent losses per participant. ISFP = Iowa Strengthening Families Program; LST = Life Skills Training program; SFP10–14 = Strengthening Families Program: For Parents and Youth 10–14; B/C = benefit–cost ratio; Net ben. = net benefit; PYMU = past-year methamphetamine use; CI = confidence interval. [a]Benefit–cost ratio and net benefit per youth for observed intervention efficacy, cost to intervene, assuming an annual real discount rate of 3%; [b]rate of past-year methamphetamine use in each intervention condition varied from 0% to 3%; [c]the intervention rate exceeded the control condition rate; [d]intervention costs increased and decreased by 10% from observed; [e]prevention benefit increased and decreased by 10% from estimate; [f]prevention effect decreased linearly from observed level to 0 across 5, 10, and 20 years; [g]discount rate varied from 3% to 8%.

graduation. Combining intervention effectiveness with an average college graduation rate of 37.2% (U.S. Census Bureau, 2005) and 6 years of NSDUH data indicating the probability of college graduation as 2.3 times greater for those who do not use methamphetamine before age 18, overall college graduation rates would be projected to increase by 0.8% for ISFP, 0.5% for LST only, and 0.4% for LST + SFP10–14. This indicates that prevention programming can also yield employer benefits by generally increasing labor force skills and productivity through education. Moreover, across a career, a college education generates an additional $1,211,000 of income and $153,000 of tax revenues (Kantrowitz, 2007), further indicating the importance of this outcome.

Discussion

Results of the current analysis demonstrate the economic potential of science-based prevention programs designed for general populations. Economic analyses predicted that the positive prevention effects of the intervention conditions would return more monetary benefits to employers than they cost to implement. It is important to note that these economic benefits were generated by prevention programs that were not designed to prevent methamphetamine use in particular but rather to prevent substance use, delinquency, and problem behaviors more generally, as well as to promote positive social functioning. Furthermore, the benefits considered were limited to those associated with methamphetamine use and returned to employers. As a result, the current estimates likely represent only a portion of the full economic potential of the programs investigated, and actual gains would be increased by considering benefits that accrue to other stakeholders and positive program effects on other outcomes, such as college graduation. Thus, the current analysis yields a conservative estimate of the interventions' true economic potential, which would increase as one considers more intervention effects and more beneficiaries in society. In addition, sensitivity analyses suggested the economic advantage of these programs across a range of conditions. Indeed, the LST intervention maintained positive benefit–cost results, even assuming intervention effects to dissipate after only 5 years, indicating that the findings are likely to be robust.

An important issue to consider in relation to the findings of the present study is the nature of the relationship between employee methamphetamine use and employer costs. In this analysis it was presumed that employee methamphetamine use caused these costs, which seems plausible. By contrast, a reversed direction of causality is less tenable, in that it would mean employment behaviors such as greater number of sick days, more turnover, and greater absence caused employee methamphetamine use. However, it is feasible that methamphetamine use and employer costs are both caused by one or more "third" variables that correlate with methamphetamine use. But this possibility does not threaten the general conclusion regarding the economic benefit of the prevention programs under investigation. To elaborate, the interventions do not target methamphetamine use specifically but presumably prevent methamphetamine use through more general effects that favorably affect youth broadly, positively affecting a range of attitudes, skills, and behaviors that likely influence not only methamphetamine use but that also beneficially influence employment behaviors, even though the latter may not be directly and uniquely caused by methamphetamine use. Furthermore, it is important to note that the intervention effects on methamphetamine use were observed in the context of randomized, controlled intervention trials, thereby enabling strong conclusions about the causal effect of the interventions on decreasing methamphetamine use.

Results of the current analysis demonstrate the impact of intervention costs on the economic feasibility of a prevention program. For two equally effective interventions, the intervention that costs less will be more cost-effective. To illustrate, the current analysis indicated a stronger prevention effect for ISFP compared with LST only. However, the lower cost of the LST only intervention yields more favorable estimates for cost effectiveness and benefit–cost ratio. This observation highlights the importance of increasing efficiencies in prevention programs. In part, this would entail "streamlining" interventions by identifying and maintaining those elements critical to effectiveness and shedding those activities and strategies that are not supported by the evidence. The cost of prevention programs delivered in the context of public health campaigns will also depend on means of dissemination, with potential cost advantages being realized by capitalizing on existing dissemination infrastructures, such as the public schools and the university-based Cooperative Extension Service, the latter of which has agents in every county across the nation (Spoth and Greenberg, 2005).

From a practical perspective, one may wonder why employers should care about prevention when efforts might be targeted to drug testing either to avoid hiring methamphetamine users or to fire newly discovered methamphetamine users. First, from a broad perspective, all individuals are potentially productive employees and may be viewed as resources for the labor market. Increasing the pool of employees who do not and will not use methamphetamine will be a benefit to employers. In addition, pre-employment drug testing would not detect currently abstinent methamphetamine users or those who might become methamphetamine users in the future. Second, just because an employee uses methamphetamine does not mean that that employee is entirely nonproductive. Employers who invest in employee training will want a return on that investment and may be reluctant to immediately fire methamphetamine-using employees, thereby choosing to bear some costs that might have been entirely avoided by prevention. Third, drug testing itself is costly (Barnwell and Earleywine, 2007), with positive results often leading to costly actions, such as more expensive

follow-up testing, treatment or termination, and turnover. Finally, in a larger sense, these findings should demonstrate to employers and other potential stakeholders the economic potential of prevention efforts.

Conversely, one might question the relevance of the current findings to nonemployers. Numerous other perspectives exist, including those of individuals, taxpayers, and society as a whole. However, for a drug such as methamphetamine that can have a severe impact on an individual's functioning across a broad spectrum of domains, the demonstration of economic benefit to a large and essential category of stakeholders in society bodes well for other groups of constituents. In addition, strong employers encourage economic growth, provide governmental revenue, and promote societal stability through steady employment—outcomes that benefit the whole of society.

Conclusion

Although the prevalence of methamphetamine use is relatively low, its effects can be quite severe and costly. Prevention programs can reduce methamphetamine use, but the question arises as to how much such prevention programs cost and whether their costs are economically beneficial in the long run. This article addressed this issue from the perspective of employers by calculating the cost required to prevent one individual from engaging in methamphetamine use and comparing this with the incremental benefit associated with methamphetamine abstinence stemming from increased productivity and less employee absenteeism, sickness, theft, and turnover. Of the three intervention conditions examined, all were found to be economically beneficial. Further, these favorable results were obtained from a conservative analysis that considered a circumscribed universe of benefits that accrue only to employers and did not seek to account for benefits enjoyed by the individual, society at large, or the value individuals and their families would attach to the avoidance of the very real personal, social, and emotional costs associated with methamphetamine use. Consideration of additional beneficiaries and benefits of methamphetamine prevention, combined with the additional positive effects unrelated to methamphetamine use that accompany methamphetamine prevention, would further bolster the economic feasibility of all three intervention programs examined herein. In this light, the results of this research are all the more favorable and indicate the wisdom of considering public health campaigns for broad application of effective substance use prevention programs in the general population.

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References

Aos, S., Lieb, R., Mayfield, J., Miller, M., & Pennucci, A. (2004). *Benefits and costs of prevention and early intervention programs for youth.* Seattle, WA: Washington State Public Policy Institute.

Aos, S., Mayfield, J., Miller, M., & Yen, W. (2006). *Evidence-based treatment of alcohol, drug, and mental health disorders: Potential benefits, costs, and fiscal impacts for Washington State.* Olympia, WA: Washington State Institute for Public Policy.

Association of Certified Fraud Examiners. (2006). *2006 ACFE Report to the Nation on Occupational Fraud and Abuse.* Austin, TX: Author. Retrieved from http://www.acfe.com/documents/2006-rttn.pdf

Barnwell, S. S., & Earleywine, M. (2007). Is drug testing in the workplace worthwhile? In M. Earleywine (Ed.), *Pot politics: Marijuana and the costs of prohibition* (pp. 40–70). New York, NY: Oxford University Press.

Catalano, R. F., & Hawkins, J. D. (1996). The Social Development Model: A theory of antisocial behavior. In J. D. Hawkins (Ed.), *Delinquency and crime: Current theories* (pp. 149–197). New York, NY: Cambridge University Press.

Drummond, M. F., Sculpher, J. J., Torrance, G. W., O'Brien, B. J., & Stoddart, G. L. (2005). *Methods for the economic evaluation of health care programmes* (3rd ed.). Oxford, England: Oxford University Press.

Foster, E. M., Dodge, K. A., & Jones, D. (2003). Issues in the economic evaluation of prevention programs. *Applied Developmental Science, 7,* 76–86.

Grant, B. F., & Dawson, D. A. (1997). Age at onset of alcohol use and its association with DSM-IV alcohol abuse and dependence: Results from the National Longitudinal Alcohol Epidemiologic Survey. *Journal of Substance Abuse, 9,* 103–110.

Griffeth, R. W., & Hom, P. W. (2001). *Retaining valued employees.* Thousand Oaks, CA: Sage.

Haddix, A. C., Teutsch, S. M., & Corso, P. S. (2003) *Prevention effectiveness: A guide to decision analysis and economic evaluation* (2nd ed.). Oxford, England: Oxford University Press.

Hansen, W. B., Tobler, N. S., & Graham, J. W. (1990). Attrition in substance abuse prevention research: A meta-analysis of 85 longitudinally followed cohorts. *Evaluation Review, 14,* 677–685.

Johannesson, M. (1996). The willingness to pay for health changes, the human-capital approach and the external costs. *Health Policy, 36,* 231–244.

Jones, D., Bumbarger, B., Greenberg, M., Greenwood, P., & Kyler, S. (2008). *The economic return on PCCD's investment in research-based programs: A cost-benefit assessment of delinquency prevention in Pennsylvania.* State College, PA: Prevention Research Center, Penn State University.

Kantrowitz, M. (2007). The financial value of a higher education. *Journal of Student Financial Aid, 37,* 18–27.

National Association of Counties. (2005). *The meth epidemic in America: Two surveys of U.S. counties.* Retrieved from http://www.death2meth.com/methsurveys.pdf

Nicosia, N., Pacula, R. L., Kilmer, B., Lundberg, R., & Chiesa, J. (2009). *The economic cost of methamphetamine use in the United States, 2005.* Santa Monica, CA: Rand Corporation. Retrieved from http://www.rand.org/pubs/monographs/2009/RAND_MG829.pdf.

O'Connell, M. E., Boat, T., & Warner, K. E. (Eds.). (2009). *Preventing mental, emotional, and behavioral disorders among young people: Progress and possibilities.* Washington, DC: The National Academies Press.

O'Dea, P. J., Murphy, B., & Balzer, C. (1997). Traffic and illegal production of drugs in rural America. *NIDA Research Monograph, 168,* 79–89.

Pauly, M. V., Nicholson, S., Xu, J., Polsky, D., Danzon, P. M., Murray, J. F., & Berger, M. L. (2002). A general model of the impact of absenteeism on employers and employees. *Health Economics, 11,* 221–231.

Spoth, R. L., Clair, S., Shin, C., & Redmond, C. (2006). Long-term effects of universal preventive interventions on methamphetamine use among adolescents. *Archives of Pediatrics & Adolescent Medicine, 160,* 876–882.

Spoth, R. L., & Greenberg, M. T. (2005). Toward a comprehensive strategy for effective practitioner–scientist partnerships and larger-scale community health and well-being. *American Journal of Community Psychology, 35,* 107–126.

Spoth, R. L., Guyll, M., & Day, S. X. (2002a). Universal family-focused interventions in alcohol-use disorder prevention: cost-effectiveness and cost-benefit analyses of two interventions. *Journal of Studies on Alcohol, 63,* 219–228.

Spoth, R. L., Redmond, C., Kahn, J. H., & Shin, C. (1997). A prospective validation study of inclination, belief, and context predictors of family-focused prevention involvement. *Family Process, 36,* 403–429.

Spoth, R., Redmond, C., & Shin, C. (1998). Direct and indirect latent-variable parenting outcomes of two universal family-focused preventive interventions: Extending a public health-oriented research base. *Journal of Consulting and Clinical Psychology, 66,* 385–399.

Spoth, R. L., Redmond, C., & Shin, C. (2001). Randomized trial of brief family interventions for general populations: adolescent substance use outcomes 4 years following baseline. *Journal of Consulting and Clinical Psychology, 69,* 627–642.

Spoth, R. L., Redmond, C., Trudeau, L., & Shin, C. (2002b). Longitudinal substance initiation outcomes for a universal preventive intervention combining family and school programs. *Psychology of Addictive Behaviors, 16,* 129–134.

Substance Abuse and Mental Health Services Administration. (2007). *Results from the 2006 National Survey on Drug Use and Health: National Findings* (Office of Applied Studies, NSDUH Series H-32, DHHS Publication No. SMA 07-4293). Rockville, MD. Retrieved from http://www.oas.samhsa.gov/NSDUH/2K6NSDUH/2K6results.cfm.

U.S. Census Bureau. (2005). *Statistical Abstract of the United States: 2006.* Washington, DC: Government Printing Office.

U.S. Department of Health and Human Services (Substance Abuse and Mental Health Services Administration, Office of Applied Studies). (2009). *National Survey on Drug Use and Health, 2006.* [Computer file]. ICPSR21240-v4. Ann Arbor, MI: Inter-university Consortium for Political and Social Research [distributor].

Volkow, N. D., Chang, L., Wang, G.-J., Fowler, J. S., Leonido-Yee, M., Franceschi, D., . . . Miller, E. N. (2001). Association of dopamine transporter reduction with psychomotor impairment in methamphetamine abusers. *American Journal of Psychiatry, 158,* 377–382.

Wang, L. Y., Crossett, L. S., Lowry, R., Sussman, S., & Dent, C. W. (2001). Cost-effectiveness of a school-based tobacco-use prevention program. *Archives of Pediatrics & Adolescent Medicine, 155,* 1043–1050.