

Cost-Benefit Analysis of Communities That Care Outcomes at Eighth Grade

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Abstract This paper presents a cost-benefit analysis of the Communities That Care (CTC) prevention system, a public health approach to reducing risk, enhancing protection, and reducing the prevalence of adolescent health and behavior problems community wide. The analysis is based on outcomes from a panel of students followed from Grade 5 through Grade 8 in a randomized controlled trial involving 24 communities in 7 states. Previous analyses have shown that CTC prevented the initiation of cigarette smoking, alcohol use, and delinquency by the end of 8th grade in CTC communities compared to controls. This paper estimates long-term monetary benefits associated with significant intervention effects on cigarette smoking and delinquency as compared to the cost of conducting the intervention. Under conservative cost assumptions, the net present benefit is \$5,250 per youth, including \$812 from the prevention of cigarette smoking and \$4,438 from the prevention of delinquency. The benefit-cost ratio indicates a return of \$5.30 per \$1.00 invested. Under less conservative but still viable cost assumptions, the benefit-cost ratio due to prevention of cigarette smoking and delinquency increases to \$10.23 per \$1.00 invested. Benefits from CTC's reduction in alcohol initiation as well as broader inclusion of quality-of-life gains would further increase CTC's benefit-cost ratio. Results provide evidence that CTC is a cost-beneficial preventive intervention and a good

investment of public dollars, even under very conservative cost and benefit assumptions.

Keywords Cost-benefit analysis · Community-based intervention · Prevention

Cost-benefit and other economic analyses are increasingly sought to complement prevention effectiveness studies and guide policymakers and others interested in achieving positive youth outcomes in a cost-effective way (Flay et al. 2005; National Research Council and Institute of Medicine 2009; Spoth et al. 2008). In this study we present the first cost-benefit analysis of Communities That Care (CTC), a prevention system designed to improve youth behavioral health outcomes community wide. We examine whether the CTC system, when focused on youth in late childhood and early adolescence across an entire community, is a good investment of public dollars.

CTC addresses a number of longstanding issues in translational research, including the faithful use by community-based practitioners of scientifically tested and effective preventive interventions aimed at specific, empirically derived risk and protective factors prioritized by community stakeholders (Hawkins et al. 2008). Over time, CTC is expected to increase adoption of science-based prevention approaches and lead to greater use of tested, effective preventive interventions addressing the prioritized risk and protective factors. These changes are expected to lead to changes in youth exposure to targeted risk and protective factors, and, in turn, to decreases in youth problem behaviors such as substance use, delinquency, violence, and health-risking sexual behaviors. The time-frame for achieving posited changes is 2 to 5 years for community-level effects on risk and protective factors and 4

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to 10 years for effects on community levels of youth behavior problems (Hawkins et al. 2009).

Findings from the initial 5-year randomized controlled efficacy trial of 12 CTC intervention communities and 12 control communities (2003–2008) have indicated the effectiveness of the CTC system. Four years into implementation of CTC, students in a longitudinal panel followed from Grade 5 through Grade 8 in CTC communities reported significantly lower rates of smoking initiation, smokeless tobacco use, alcohol use, and delinquency compared to their counterparts in control communities (Hawkins et al. 2009). Cost-benefit analysis places a monetary value on these significant intervention-related outcomes, based on benefits expected to accrue over the life course of participants. This study seeks to determine whether the benefits associated with the observed effects of CTC outweigh the costs of implementation. The present analysis is conservative in that it is limited to benefits from CTC's effects on cigarette smoking and delinquency because we are hesitant to apply existing long-term benefits models for alcohol use (Caulkins et al. 1999; Miller and Hendrie 2008; Miller et al. 2006; Spoth et al. 2002) to CTC given differences in the assumptions used in these models compared to the models used here, which are based on the work of Aos et al. (2004). We are not aware of models monetizing the prevention of smokeless tobacco use as distinct from cigarette smoking and so have not attempted to monetize the benefits of CTC's observed effects on smokeless tobacco use.

Prior studies have identified cost-beneficial prevention programs in early childhood education and intervention (Barnett and Masse 2007; Belfield et al. 2006; Karoly et al. 2005; Temple and Reynolds 2007), home visitation services to low-income mothers and their children (Barnett 1993), intensive foster care (Zerbe et al. 2009), and substance abuse prevention (Plotnick et al. 1998; Spoth et al. 2002). We use the term “cost beneficial” rather than “cost effective” throughout this paper because our focus is on program benefits expressed in dollar terms, and the latter term may be used in association with non-financial outcomes. Early childhood education programs for children from poverty have received the greatest attention in the prevention cost-benefit literature. Several comprehensive preschool programs for children from low-income families, including those from efficacy trials as well as sustained community-based approaches, have been found cost beneficial, based on a combination of realized and projected lifetime gains (Barnett and Masse 2007; Belfield et al. 2006; Temple and Reynolds 2007). Findings have resulted in well-justified promotion of these early intensive interventions for children from poverty, which have yielded high rates of return on dollars invested (Heckman and Masterov 2007; Heckman et al. 2010). They underscore

that combining economic evidence with other intervention data can bolster public support for effective prevention efforts.

In the most comprehensive cost-benefit analysis of preventive interventions for youth, Aos et al. (2004) examined 60 programs targeting various ages and outcomes and identified 37 that generated benefits to society that exceeded their costs. Net benefits and returns on investment varied widely in all intervention categories and across ages, but cost-effective programs had some characteristics in common. They reduced crime (lowering criminal justice system and victim costs), increased educational attainment (associated with higher wages over lifetimes), and/or reduced substance abuse (achieving health and earnings benefits at relatively low cost). A few programs affected child abuse and neglect (leading to large reductions in victim and public costs of substantiated cases). Aos et al.'s (2004) work shows that strong returns to investment in prevention can be found throughout the childhood and adolescent years, depending on the intervention cost structure and outcomes achieved. However, some programs evaluated by Aos et al. (2004) did not have positive economic returns. It is important to test the return on investment of each prevention program.

Several factors are related to reliability in cost-benefit conclusions: (a) uncertainty in intervention effect sizes; (b) accuracy of cost information, including operating, capital, and opportunity/time costs (Foster et al. 2003, 2007); (c) the scope, modeling, and timing of the benefits analysis; (d) the perspective of different potential beneficiaries (e.g., participants, taxpayers, and the general public); and (e) choice of an appropriate discount rate (3% real rate of return on financial capital is standard, but 0% - 7% may be reported given future uncertainty; Aos et al. 2004; Sloan et al. 2004; Temple and Reynolds 2007; Zerbe et al. 2009). Whether effects found in research studies will be realized in the real world depends on research design quality as well as inherent uncertainty and error in translational work. Aos et al. (2004) identified several features related to the likelihood that research-based effects will be replicated in widespread implementation, including the use of large samples, inclusion of data on attrition, quality outcome measures, and random assignment with well-matched treatment and control groups. When these are present, effect sizes are more likely to be reliable.

Benefits estimation in cost-benefit analysis is complex. The scope of benefits considered, assumptions about future events, and the point at which benefits are measured all affect estimates. Most researchers adopt a relatively narrow scope, limiting models primarily to tangible benefits (e.g., increased earnings, increased labor productivity) or tangible avoided costs (e.g., decreased medical expenditures, reduced criminal justice system costs). Although researchers

have identified intangible benefits associated with some intervention outcomes (e.g., improved quality of life related to better health; Sloan et al. 2004), these benefits can be difficult to monetize and often are not included in cost-benefit analysis (Karoly et al. 2005; Temple and Reynolds 2007). A notable exception is the intangible, quality-of-life effect associated with violent crime, increasingly requested by policymakers and included in cost-benefit analyses (Barnett and Masse 2007; Belfield et al. 2006; Reynolds et al. 2011).

Benefits models often rely on projections, or simulations, over the life course of participants. Reliability is strengthened when models are based on empirical work linking present and future behavior. For example, benefits models pertaining to the prevention of adolescent tobacco use draw on substantial empirical research linking adolescent usage patterns to adult tobacco use (Breslau and Peterson 1996; Caulkins et al. 1999; Grant 1998). The mortality and health-related consequences of tobacco use also have strong empirical foundations (Sloan et al. 2004). In addition, nationally representative databases can be utilized to model prevalence, age of onset, cessation, and relapse patterns in the general population well into old age when most costs of use are incurred. Delinquency models similarly benefit from empirical work linking adolescent delinquent behavior to future crime (Cohen and Piquero 2009; Piquero et al. *in press*), as well as from publicly available data on crime and criminal justice system costs (e.g., FBI's Uniform Crime Reports; National Crime Victimization Survey). Unlike substance use, crime tends to peak by age 18 and drop off rapidly. Most delinquency models therefore include expected costs of crime only through the mid 30s (Aos et al. 2004).

Although benefits based on actual data are ideal, long-term follow-up of intervention participants into adulthood has been rare. However, two recent cost-benefit analyses of preschool intervention programs for children from poverty were even stronger than follow-ups completed at younger ages, lending support to simulation methods as well as suggesting the enduring, rather than decaying, effects of certain preventive interventions (Belfield et al. 2006; Reynolds et al. 2011; Temple and Reynolds 2007).

Given findings about the effects of CTC with respect to youth tobacco use and delinquency, the present study sought to determine whether the intervention was cost beneficial. The analysis differs from earlier cost-benefit prevention studies in that the preventive intervention is a universal, community-wide intervention for all youth ages 10–14. Youth behavioral outcomes are linked not to a specific program utilized within a community, but rather to the community-level CTC intervention as a whole. CTC's effects are derived from a randomized controlled trial with adequate sample size and power to detect effects,

suggesting that cost-benefit findings should be reliable (Aos et al. 2004).

We address three questions in this cost-benefit analysis: (1) What is the cost of implementing CTC, for the community and on a per-youth basis; (2) what benefits can be expected to accrue to society over the long term, based on findings at eighth grade that CTC significantly prevents youth cigarette smoking and delinquency initiation; and (3) is the CTC intervention, which spreads costs throughout an entire community, cost beneficial? That is, does CTC's community-wide investment in youth ages 10–14 generate positive returns over time from the perspectives of participants, taxpayers, and the general public?

Methods

Data are from the Community Youth Development Study (CYDS) (Hawkins et al. 2008), the first community-randomized trial of CTC. Twenty-four communities in the states of Colorado, Illinois, Kansas, Maine, Oregon, Utah, and Washington were matched in pairs within state, on population size, racial and ethnic diversity, economic indicators, and crime rates. One community from each matched pair was assigned randomly by a coin toss to the intervention (CTC) or control condition. At the start of the study none of the 24 communities had advanced in the use of science-based prevention to the point of selecting and using tested, effective preventive interventions to address prioritized community risks. Participating communities are small- to moderate-sized incorporated towns with their own governmental, educational, and law enforcement structures (population range: 1,500 - 50,000, $M=17,270$, $SD=10,594$).

CTC training and implementation began in the 12 intervention communities in the summer of 2003. Six CTC trainings were delivered over the course of 6 to 12 months by certified CTC trainers. CTC coalition members were trained to use data from surveys of community youth to prioritize risk factors to be targeted and to select and implement tested and effective prevention programs to address them. CTC communities were asked to focus their prevention plans on programs for youth aged 10 to 14 years (Grades 5 through 9) and their families and schools so that possible effects on substance use, delinquency, and other outcomes could be observed within the grant period. Because CTC communities themselves prioritized which risk and protective factors to target and which tested and effective programs to implement, the number and types of programs implemented in each community vary. Starting with the 2004–2005 school year, CTC communities implemented from one to five preventive programs in each year to address their prioritized risk factors ($M=2.75$, $SD=0.89$; Fagan et al. 2008). Study implementation staff

provided technical assistance aimed at ensuring faithful implementation of prevention programs throughout the efficacy trial (2003–2008) through emails, weekly phone calls, and site visits to CTC communities at least once per year. Technical assistance ended after the 5th year of the study.

Student Sample

A panel of 4,407 students in CTC and control communities was recruited initially at fifth grade and surveyed annually in the spring (2003–2004 through 2007–2008 school years). Their reports about tobacco use, delinquency, and other behaviors were used to identify the effects of CTC on youth outcomes. The first wave of data was a pre-intervention baseline assessment. Baseline rates of tobacco use and delinquency were comparable in CTC and control communities in fifth grade (Brown et al. 2009). Findings presented here are from the 4th year of the study when participants were in the eighth grade and had received just under 3 years of the preventive intervention. The flow of communities and students through the randomized controlled trial is described in Hawkins et al. (2009).

Community Youth The panel included all consenting fifth-grade students in each community, but CTC prevention programs targeted all youth from fifth to ninth grade, covering ages 10–14. Cost-per-youth calculations described below are based on the total youth in each CTC community between the ages of 10–14, obtained from the 2000 U.S. Census.

Measures

Youth outcomes data (initiation of cigarette smoking and delinquency) are from the Youth Development Survey completed annually by the student panel. This self-administered paper-and-pencil survey, designed to be completed in a single 50-minute class period, consists of approximately 220 items asking youth about their experiences along multiple dimensions, including problem behaviors, as well as observations about family, school, peer, and community (Brown et al. 2009). Initiation of tobacco use was ascertained from the question, “Have you ever smoked a cigarette, even just a puff?” Delinquency initiation was measured from nine items indicating delinquent behavior, including *stealing, property damage, shoplifting, attacking someone, carrying a gun to school, beating up someone, stealing a vehicle, selling drugs, or being arrested*. The calculation of initiation rates for tobacco use and delinquency, and analyses identifying significant differences in initiation in CTC compared to control communities, are reported in Hawkins et al. (2009).

CTC Implementation Cost

Costs of CTC were estimated from bills and documentation submitted by CTC communities to the University of Washington Social Development Research Group (SDRG). Implementation costs were also incurred by SDRG intervention specialists who supported CTC communities throughout the grant period. Costs were assigned to four major categories: (1) community coalition; (2) intervention programs; (3) training, technical assistance, and implementation monitoring; and (4) other costs. Costs were summed to determine annual and total intervention costs for each CTC community. *Community coalitions* were central to CTC implementation. Each community hired a program coordinator to facilitate the enhancement or formation of a coalition of community stakeholders and the coalition’s tasks of assessing and targeting for intervention risk and protective factors within the community, developing an action plan for addressing targeted factors, choosing tested and effective programs focusing on targeted factors, and monitoring and evaluating the programs implemented. Coalition costs consisted primarily of coordinator salaries and related administrative costs, including those for coalition meetings.

The use of tested and effective intervention programs is the second cost of the CTC intervention. All programs implemented had been found effective at reducing drug use, delinquent behavior, or youth risk factors in prior controlled studies. Use of these programs required paying for program materials, training for staff in the community to implement the program, implementation staff time, and in some cases, incentives, meals, and child care or other supports for participants deemed important for successful program implementation.

Ongoing training, technical assistance, and implementation monitoring were provided by two organizations. Certified CTC trainers employed by the Channing Bete Company, the distributor of CTC between 2000 and 2005, conducted training sessions focusing on implementing the major aspects of CTC. Implementation specialists at SDRG further supported communities by monitoring faithful implementation of CTC and tested and effective intervention programs, administering youth surveys and providing feedback to communities about risk and protective factors, making regular phone calls and annual site visits, and mailing information, such as prevention-related newsletters, to families of students in the intervention. Costs included training sessions, staff salaries, office rental, materials, travel, phone, mailing, and survey administration. Salary and office rent were prorated based on the portion of time spent on the intervention.

Finally, some *other costs* were incurred during the intervention. Grant support to communities was reduced intentionally in the last 2 years of the intervention as a way

of encouraging communities to obtain their own funding for CTC, an important step for long-term sustainability of the intervention. Ten communities obtained additional support for CTC implementation in Years 4, 5, or both. Costs were also incurred in the form of in-kind contributions, such as the cost of substitutes during teacher training periods, additional incentives for participants, and cash donations in support of CTC prevention programs. These additional resources were included as other costs of the CTC intervention.

Sensitivity Analysis: Coalition Board Member, Volunteer, and Teacher Time Costs Coalition board members, prevention program volunteers, and teachers all contributed time to the CTC intervention. Direct expenditures were not incurred for this time by communities because boards typically met outside of normal working hours, and volunteers gave their free time to support programs. Regarding teacher time, in some communities a CTC school-based prevention program replaced another prevention program, but in others, it replaced classroom instructional time on other topics. It is possible that prevention activities facilitated learning and achievement. As a result, the marginal teacher time spent on prevention activities and away from traditional student learning activities varied widely across communities. However, to acknowledge the time cost for these individuals, as well as the possibility that some volunteer labor could have an explicit cost in later CTC implementations, we conducted a sensitivity analysis. It includes coalition board member and program volunteer labor costs, and 100% of the time teachers spent delivering CTC school-based prevention programs, even though this overstates the marginal cost of teachers in conducting CTC prevention activities.

We estimated time costs by multiplying the total volunteer board hours and teacher hours spent delivering prevention programs in each community by state-specific wage rates provided by the Bureau of Labor Statistics (BLS) (Bureau of Labor Statistics 2009). We used the state average wage rate across all occupations (category 00–0000) for board member time because of the diversity of board membership. Teacher hourly wages for classroom time with students were estimated from annual wages for middle school teachers (category 25–2022) following the method used by Foster et al. (2007). We estimated volunteer costs by type of program, not by community, using the national average for Social and Human Service Assistants (category 21–1093). This job category most resembles the type of work that CTC volunteers would perform in support of prevention programming. The national average fringe benefits rate for all civilian workers was added to volunteer board and program volunteer wages (Bureau of Labor Statistics 2011). The national average fringe benefits rate for state and local government workers was added to teacher wages.

CTC Benefits

This analysis of benefits is limited to empirically supported, monetizable effects of the CTC intervention on tobacco use initiation and delinquency. Detailed descriptions of the benefits models used in this study can be found in Aos et al. (2004, Technical Appendix, “Valuation of Crime Outcomes” pp. 37–46, “The Costs of Tobacco Consumption” pp. 61–63). Benefits are projected over the lifetime of participants utilizing several bodies of research and databases: (a) empirical work linking adolescent tobacco use and delinquency initiation to, respectively, future adult tobacco use and crime; (b) empirically established relationships between (1) cigarette smoking and mortality and health, and (2) crime and criminal justice system and victim costs; and (c) several national datasets, including the Current Population Survey, National Survey on Drug Use and Health, and the National Crime Victimization Survey.

The models consist of tangible benefits (e.g., increased earnings) and tangible avoided costs (e.g., decreased medical expenditures, reduced criminal justice system costs) associated with preventing cigarette smoking and delinquency. They also include intangible effects (e.g., pain, suffering, quality of life) associated with violent crime, consistent with general current practice (Aos et al. 2004; McCollister et al. 2010; Miller et al. 1996).

Prevention of Tobacco Use Initiation Those who start smoking as adolescents are significantly more likely than nonsmoking youth to become lifetime smokers (Breslau and Peterson 1996; Caulkins et al. 1999; Grant 1998). Programs like CTC that prevent smoking initiation in adolescents generate future benefits because of associated reductions in adult smoking, which in turn result in reductions in early mortality and illness.

We estimate benefits from delays in the initiation of smoking by multiplying the expected cost of adult cigarette smoking per person by CTC’s effect on the initiation of adolescent smoking per youth and by a factor reflecting the effect of delayed adolescent smoking on the likelihood of becoming an adult smoker. Per adult smoker, the model values lost future earnings and taxes due to premature death, as well as medical expenditures (i.e., ambulatory care, hospital care, prescription drugs, nursing homes, and other care) (Aos et al. 2004) associated with 19 smoking-attributable diseases. Because of the early mortality of smokers relative to nonsmokers, some medical expenditures incurred late in life are avoided; medical costs are accordingly reduced in these years. Benefits are estimated to age 74 to capture effects that occur well into older age.

Prevention of Delinquency Initiation When delinquent behavior is averted, cost savings are achieved because

criminal justice system activity and/or victimization costs are avoided. Savings depend on a number of factors, including the type of crime committed, the probabilities of arrest and conviction, the age of the offender, and whether it is a first offense, among others. We utilize a crime model accounting for complex relationships between these factors and incorporating four broad sets of inputs which determine the lifetime expected crime cost per person in the general population: (1) unit cost of police/sheriffs (per arrest), courts and county prosecutors (per conviction), and corrections facilities (per average daily population), including marginal operating costs and capital costs; (2) units used per crime type, including sentencing probabilities, number of years per sentence, and changes in sentencing when recidivism occurs; (3) likelihood of arrest, conviction, and recidivism for different populations (e.g., general population, juvenile offender, adult offender) and different types of crime; and (4) victimization costs per unit of crime. Victimization costs are both tangible (e.g., medical and mental health, property damage, loss of earnings) and intangible (e.g., pain, suffering, lost quality of life).

Prevention programs like CTC reduce the likelihood of delinquency, and, therefore, of incurring costs in the above categories. Benefits are estimated by multiplying expected lifetime crime costs per person in the general population by CTC's per-youth effect on the initiation of delinquency. Benefits are estimated to age 32 because of the availability of empirical data and because most crimes are committed by this age.

Discount Rate and Constant Dollar Conversion Future benefit streams are discounted at an annual rate of 3% to 2004, when the CTC intervention began. Intervention costs in multiple years are converted from nominal to constant 2004 dollars using the implicit price deflator for personal consumption expenditures (National Bureau of Economic Analysis 2010). All costs are also discounted to 2004 at a 3% annual discount rate.

Data Analysis

To determine whether CTC is a good investment, eighth-grade findings are used as an early estimate for benefits from the full 5-year CTC intervention. Cost estimates correspondingly cover the full 5 years. The analytic strategy has three parts. First, we calculate the *average cost per youth* of the CTC intervention. Second, we calculate the *life-course benefits* related to CTC's significant preventive effects on youth cigarette smoking and delinquency. Third, we *compare per-youth costs and benefits*, both expressed in discounted 2004 dollars.

CTC Cost per Youth Different implementation choices (type and number of programs implemented), combined with differences in community size, could lead to a range of CTC intervention costs per youth among sample communities. Because some fairly large implementation costs (e.g., community coordinator, the need for training in each community, and the cost of purchasing program curricula) were fixed, regardless of youth population, average CTC intervention costs might be skewed by a few communities at extremes of the population distribution. We calculated CTC cost per youth in three different but viable ways and analyzed the sensitivity of results to different estimates: (1) *simple average cost per youth*, the average of 12 individual CTC community cost-per-youth values (which may give undue weight to communities at the extremes of the population distribution); (2) *average cost per youth weighted by community size* (which moderates the effect of communities at population extremes); and (3) *median cost per youth* (less sensitive to extreme population effects).

CTC Benefit per Youth Adjusted odds ratios representing significant differences in the likelihood of initiating tobacco use or engaging in delinquent behavior in CTC vs. control communities were converted to standardized mean difference effect sizes, using a transformation procedure developed by Cox (Sanchez-Meca et al. 2003). These effect sizes were used to estimate changes in outcomes expressed in units valued by the Aos et al. (2004) benefits models. For example, the smoking benefits model is based on reductions in adult cigarette smoking. The standardized mean difference effect size is first converted to expected delay in smoking initiation expressed in years. Years of delay in adolescent smoking is then converted to an expected reduction in adult cigarette smoking, based on studies establishing that linkage. The reduction in adult cigarette smoking is valued by the smoking benefits model, and the result is CTC's smoking-related benefit per youth. Total benefit per youth is the sum of benefits from preventing adolescent cigarette smoking and delinquency initiation. Benefits are estimated for various stakeholders, including program participants, taxpayers who fund the intervention, and the general public who may benefit, for example, from reductions in future crime. Benefit allocations to each stakeholder are generated from the benefits models.

Cost-Benefit Calculations We calculate two common summary indicators: *net present benefit per youth participating in CTC* and *CTC benefit-cost ratio*. Net present benefit is the total CTC benefit per youth less the CTC cost per youth. A positive value indicates a favorable investment. The CTC benefit-cost ratio divides benefit per youth by cost per youth. Values greater than one are desirable. This

measure can be interpreted as the dollar amount generated from each dollar invested in CTC.

prevention of tobacco use and 1.41 for the prevention of delinquency initiation, corresponding to standardized mean difference effect sizes of .353 for tobacco use initiation and .208 for delinquency initiation.

Results

Effect Sizes

Eighth graders in control communities were significantly more likely to initiate tobacco use and delinquency compared to eighth graders in CTC communities (tobacco use: 9.4% CTC vs. 15.1% control; delinquency: 3.7% CTC vs. 4.7% control). Adjusted odds ratios were 1.79 for the

CTC Cost per Youth

CTC cost data for the entire 5-year intervention are presented in Table 1 in discounted 2004 dollars. An average of \$637,014 was spent in each community over the 5 years of the intervention, approximately \$127,403 per year. Total expenditures ranged from \$592,666 to \$714,067 across the 12 communities, but two thirds of CTC communities spent

Table 1 Average CTC implementation cost per community (2004 discounted dollars)

Cost category	Year 1 15 months (3/03-6/04)	Year 2 12 months (7/04-6/05)	Year 3 12 months (7/05-6/06)	Year 4 12 months (7/06-6/07)	Year 5 9 months (7/07-3/08)	Grand total
Community coalition & intervention program costs						
Coalition	\$55,126	\$51,438	\$51,821	\$46,722	\$30,742	\$235,848
Intervention programs	9,873	61,035	68,003	56,461	30,200	225,572
Training, technical assistance, & implementation monitoring						
CTC trainings	8,136	7,662	7,209	6,776	6,361	36,144
Salary	17,073	19,742	21,973	20,450	12,738	91,976
Rental space	1,665	1,796	1,845	1,195	715	7,216
Travel	780	389	1,071	743	471	3,454
Phone	263	237	207	141	104	952
Targeted mailings	0	341	725	707	251	2,024
Student survey	2,605	0	2,238	0	2,007	6,850
Other costs						
Additional funding	0	0	0	8,278	8,789	17,067
In-kind donations	0	1,298	2,176	2,406	3,274	9,154
Cash donations	42	234	372	110	0	758
Subtotal costs						
Coalition	\$55,126	\$51,438	\$51,821	\$46,722	\$30,742	\$235,848
	58%	36%	33%	32%	32%	37%
Intervention programs	9,873	61,035	68,003	56,461	30,200	225,572
	10%	42%	43%	39%	32%	35%
Training, technical assistance, & implementation monitoring	30,522	30,168	35,268	30,012	22,646	148,616
	32%	21%	22%	21%	24%	23%
Other	42	1,532	2,548	10,794	12,063	26,979
	0%	1%	2%	8%	13%	4%
Total average cost per community	\$95,562	\$144,173	\$157,640	\$143,988	\$95,651	\$637,014
<i>SD</i>	17,468	12,486	10,264	20,564	12,957	37,501
<i>SD</i> as a % of total average cost per Community	18%	9%	7%	14%	14%	6%
Minimum	64,259	128,753	142,638	108,435	81,382	592,666
Maximum	122,467	175,096	175,861	175,153	119,287	714,067

within 6% of the average cost. Just over one third of these funds went to program coordinators, another third to intervention programs, and approximately one quarter to training, technical assistance, and implementation monitoring. Other costs represented just under 5% of the total, but they grew steadily from 0% to 13% over the 5 years of the intervention as communities took increasingly greater responsibility for generating funding for CTC.

Youth population data for each of the 12 CTC communities are presented in the bottom portion of Fig. 1. The number of youth age 10–14 ranged from 121 to 2,654 ($M=1,242$, $SD=703$) and represented, on average, 7.5% ($SD=1.0$) of the total community population ($M=17,270$, $SD=10,594$, range: 1,578 to 40,787). Two thirds of CTC communities had 1,000 - 2,000 youth age 10–14, and only one community had over 2,600. There were three very small CTC communities, each having fewer than 500 youth age 10–14. One community had only 121 youth age 10–14.

The top portion of Fig. 1 displays the total cost per youth for the 5-year intervention in each of the 12 CTC communities, arranged in order of youth population. The chart shows an inverse relationship between community

size and cost per youth, related to fixed CTC costs for program coordinators; much of the training, technical assistance, and monitoring costs; and some components of intervention programs. Per-youth costs in the largest community were not much different from those of more typically sized communities, but the three smallest communities, each with fewer than 500 youth age 10–14, experienced very high costs per youth, skewing the average per-youth cost. The average cost per youth was \$991 and, as shown in Fig. 1, it was several hundred dollars per youth higher than the average cost per youth in the other 75% of CTC communities. The median cost per youth was \$542, and the weighted average was \$513. These measures better reflect the per-youth cost in most sample communities. We present benefit-cost results for the range of cost-per-youth estimates.

CTC Benefit per Youth

Per-youth benefits from CTC participation are presented in Table 2. Smoking-related benefits total \$812 per youth, including \$181 from reductions in mortality and \$631 from improvements in health. Of these benefits, \$671 accrue to participants over their lifetimes, and taxpayers accrue another \$141 per participant. The delinquency-related benefit from CTC implementation is \$4,438 per youth: \$2,033 from reductions in criminal justice system costs which accrue to taxpayers, and \$2,405 from reductions in victim costs which accrue to the general public. The combined CTC benefit based on the prevention of smoking and delinquency initiation is \$5,250 per youth, with \$671 (13%) to participants, \$2,173 (41%) to taxpayers, and \$2,405 (48%) to the general public. These figures are likely to underestimate the full benefit of CTC participation because they do not include benefits related to the prevention of alcohol and smokeless tobacco use initiation observed at the end of eighth grade.

Benefit-Cost Calculations

Table 2 also summarizes CTC benefit-cost calculations under the three cost-per-youth scenarios: simple average, weighted average, and median. Net present benefits range from \$4,259 under the highest simple average cost-per-youth scenario, to \$4,737 when the weighted average cost-per-youth value is used. Benefit-cost ratios similarly show that CTC is a good investment for communities. Findings suggest that the return per dollar invested in CTC ranges from a minimum of \$5.30 when the simple average cost-per-youth figure is used, to \$10.23 when the weighted average cost-per-youth figure is used. The inclusion of benefits stemming from reductions in the initiation of alcohol and smokeless tobacco use would yield even higher returns per dollar invested.

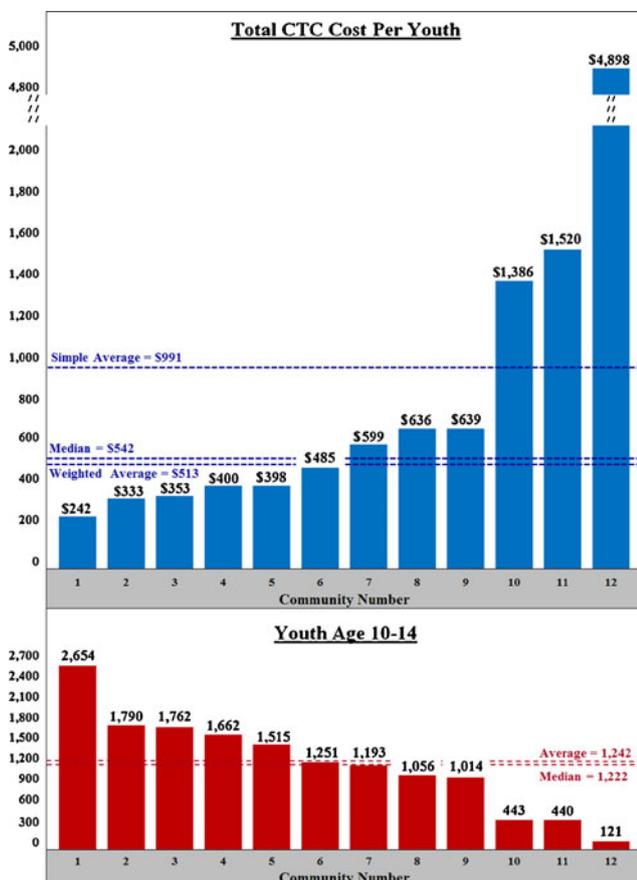


Fig. 1 The relationship between CTC cost per youth (discounted 2004 dollars) and youth population

Table 2 CTC benefit-cost calculations under different cost scenarios (2004 discounted dollars)

Benefit-cost calculations	Smoking	Delinquency	Total	Sensitivity analysis ^b
CTC benefits per youth				
Participants ^a	\$671	\$0	\$671	
Taxpayers	140	2,033	2,173	
General public	0	2,405	2,405	
Total	\$812	\$4,438	\$5,250	
CTC cost per youth				
Simple average			\$991	\$1,090
Weighted average			513	580
Median			542	591
Net present benefit per youth under different cost scenarios				
Simple average			\$4,259	\$4,160
Weighted average			4,737	4,670
Median			4,708	4,658
Benefit per dollar invested in CTC under different cost scenarios				
Simple average			\$5.30	\$4.82
Weighted average			10.23	9.06
Median			9.69	8.88

^a Benefits to participants, taxpayers, and the general public represent the average to different stakeholders. Range of benefits: Smoking benefits to participants \$670–\$672, taxpayers \$139–\$141; delinquency benefits to taxpayers \$2,022–\$2,103, general public \$2,335–\$2,416

^b Additional *non-budgetary* time costs included in sensitivity analysis: Coalition board member time, program volunteer time, teacher time preparing for and delivering preventive interventions

Returns per dollar invested can be calculated for participants, taxpayers, and the general public using data reported in Table 2. Benefit-cost ratios range from \$0.68 to \$1.31 for participants, \$2.19 to \$4.24 for taxpayers, and \$2.43 to \$4.69 for the general public for each \$1.00 invested in CTC, depending on the cost-per-youth scenario being examined. These values suggest that CTC is a good investment for each of the three groups of stakeholders, except when participant benefits are compared to the simple average cost per youth.

Sensitivity analysis: Coalition board member, volunteer, and teacher time costs. When we include these time costs, the average community cost increases by 13.0% to \$719,888, or \$143,978 per year. Simple average cost per youth increases to \$1,090, with the median cost increasing to \$580 per youth and the weighted average cost to \$591 per youth. Although per-youth costs increase when time is accounted for, there are no associated cash outflows, and, therefore, communities do not need to budget additional funds for CTC. As shown in Table 2, CTC remains a cost-beneficial investment even when time costs are considered. Net present benefits per youth decline modestly to \$4,160 - \$4,670, depending on which cost-per-youth figure is used. Benefit-cost ratios remain favorable, ranging from \$4.82 per dollar invested under the simple average cost-per-youth scenario, to \$8.88 and \$9.06, respectively, under median and weighted average cost-per-youth scenarios.

Discussion

Results indicate that CTC is a cost-beneficial way to prevent adolescent tobacco use and delinquency initiation, even under a very conservative cost estimate of \$991 per youth over 5 years. Communities willing to invest in CTC can expect to generate long-term benefits of at least \$5,250 per youth (in 2004 discounted dollars). Net present benefits were found to be \$4,259, or \$5.30 for every dollar spent on CTC. CTC's benefits accrue from reduced smoking-related mortality, better health, lower medical expenditures, and lower criminal justice system and crime victimization costs in the near and long term. The major dollar benefit derives from long-term reductions in crime (\$4,438), with smaller benefits stemming from the prevention of adolescent cigarette smoking (\$812). Multiple stakeholders benefit from the investment in CTC, with \$671 to participants, \$2,173 to taxpayers, and \$2,405 to the general public.

We analyzed the sensitivity of our findings to alternative viable cost assumptions. Median and weighted average costs of \$513 to \$542 per youth are arguably more representative of the CTC per-youth cost in most communities. Under these cost scenarios, CTC generates even higher returns, \$9.69 to \$10.23 per dollar invested, or \$4,707 to \$4,738 in net present benefits per youth. We also conducted analyses that added costs for coalition member time, volunteer time, and teacher time delivering interven-

tions. These analyses do not imply any additional direct budgetary expenditures for communities but acknowledge the value of time spent by various community individuals on prevention activities. They result in an increase in the average CTC cost from \$991 to \$1,090 per youth, decreasing net present benefits to \$4,160 per youth and the benefit-cost ratio to \$4.82 per dollar invested. Our sensitivity analysis suggests that on a per-youth basis, CTC costs from \$513 - \$1,090, generates \$4,160 - \$4,737 in net present benefits, and returns \$4.82 - \$10.23 per dollar invested. Regardless of the cost scenario, CTC proved to be a cost-beneficial investment.

The majority of intervention costs were for community-based coalitions (37%, primarily coordinator salaries); intervention programs (35%); and training, technical, assistance, and monitoring (25%). The last category was essential to the faithful implementation of preventive interventions previously found effective at reducing risks and enhancing protective factors in youth. Although these costs are a large portion of CTC's total, previous efforts to disseminate effective interventions have suffered when not executed faithfully. The investment in technical support is likely important to achieving the effects observed. Communities also showed an increasing capacity to generate intervention funding for tested and effective preventive interventions (which increased from 0% to 13% of annual expenditures over the 5-year intervention).

Like some other cost-beneficial prevention programs, CTC's design spreads costs over a large number of participants and affects multiple outcomes, including delinquency. However, a critical issue for CTC is who bears this cost and who enjoys the benefit. Taxpayers ultimately may fund the intervention, but communities make current expenditures for benefits that may be reaped outside the community far into the future. A discussion of how to share CTC costs among various stakeholders is beyond the scope of this paper, but at a minimum, states or the federal government could provide training, technical assistance, and monitoring because of efficiency gains related to economies of scale in their provision. This would save communities 25% of the cost of CTC. For many communities, CTC represents an alternative to current practices, meaning that resources required for CTC could be diverted from less effective uses, resulting in lower incremental intervention costs.

This study has limitations. With respect to benefits, this analysis underestimates CTC's positive impact in two ways. First, CTC's significant effects on the prevention of alcohol use and smokeless tobacco use initiation have not been monetized in the analyses presented above. We are not aware of benefits models specific to smokeless tobacco and so did not estimate economic benefits associated with that outcome. We did not monetize CTC's effects on alcohol use

initiation because Aos' models for this are undergoing revision. However, Miller and Hendrie (2008) have developed a substance use prevention model that indicates that CTC might generate an additional \$1,466 in benefit per youth through reductions in youth alcohol initiation, or an additional \$1.48 per dollar invested in CTC. Second, our estimates are conservative in that quality-of-life gains are included only for CTC's delinquency outcome. Here again, Miller and Hendrie (2008) are instructive in providing an alternative viewpoint. Their model indicates that quality-of-life gains from CTC's prevention of cigarette smoking and alcohol initiation are large, and would generate an additional economic benefit of \$6.13 and \$2.01 per youth, respectively. We present these data with caution because Miller and Hendrie's model differs somewhat from the models used in our analysis. However, it confirms that CTC is a cost-beneficial intervention, even without considering potentially substantial quality-of-life gains related to the prevention of cigarette smoking and alcohol use.

In focusing on the cost to implement CTC, we may have overestimated the incremental investment required by communities to achieve CTC's outcomes. Communities could choose to implement CTC as an alternative to conducting business as usual, which would result in lower incremental implementation costs. On the other hand, estimated costs do not include the cost to parents of participating in family-focused prevention programs. However, we also do not monetize potential benefits to parents. For example, parents may have benefited from improved relationships with their children, and enhanced parenting skills may have affected other children in the home.

Another limitation concerns the use of projected rather than actual data to estimate benefits. Actual data from long-term follow-up would be ideal but are not yet available. However, recent analyses show that eighth-grade effects of CTC in preventing the initiation of tobacco use, alcohol use, and delinquent behavior were maintained in 10th grade (Hawkins et al. *in press*), and the projection models used here include conservative assumptions that strengthen confidence in conclusions drawn. In fact, some recent long-term follow-up studies found that benefits estimates increased as participants aged, giving confidence to projected estimates from younger ages (Belfield et al. 2006; Reynolds et al. 2011). Delinquency benefits models also drew on a mix of national and Washington State data to estimate criminal justice system costs across the seven states in this study, leading to some imprecision in the delinquency benefits estimate.

Results raise questions about whether CTC is a good investment for very small communities, those with fewer than 500 youth age 10–14. It may be that the fixed costs associated with the program are too high for the CTC system to be cost beneficial in very small communities.

However, if implementation costs are compared to current investments in prevention services, and a broader set of benefits (including effects on adolescent alcohol use) are monetized, the net investment in CTC might prove more favorable in these communities.

At this point, evidence indicates that CTC is a cost-beneficial approach to reducing youth tobacco use and delinquency community wide based on eighth-grade outcomes obtained after 4 years of a randomized controlled trial. This CTC cost-benefit analysis is unique in demonstrating that a universal, community-wide prevention system aimed at late childhood/early adolescent youth and successful in reducing tobacco use and delinquency in early adolescence can be cost beneficial. When communities focus on risk and protective factors they consider important, and faithfully implement scientifically tested and effective programs to address their priority risks, favorable youth outcomes can be achieved in a cost-beneficial manner.

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