25
Economic Analysis and Policy Studies
Special Challenges in the Prevention Sciences[1]

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25.1 Introduction

There is growing pressure to view prevention interventions as "investments" in the public good and to hold them accountable for yielding favorable returns in the way that private investors expect financial investments to yield favorable financial returns. We call this enterprise "economic analysis" because the more familiar terms "cost-benefit" and "cost-effectiveness" refer to specific methods within this broader toolkit. And while "cost analysis" has also been used to name the broader toolkit, we prefer the label "economic analysis" to stress that importance of economizing the limited resources (e.g., money) available to society for these various programs.[2] Whatever the name, these expectations for accountability push beyond the familiar demands that programs be "evidence-based" and

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[1] In Sloboda, Z. and Petras, H. (forthcoming) Advances in Prevention Science: Defining Prevention Science, New York:Springer Publications

[2] We do not use the term "economic analysis" in the sense that these methods belong to the discipline of economics, as this broad toolkit is not only or primarily used by economists. Moreover, only one of the tools in the toolkit (cost-benefit analysis) comes directly out of welfare theory in economics.

documented and maintain high fidelity with model program guidelines.

This chapter reviews core challenges that arise when applying such economic analysis to public policies and programs and are particularly salient when evaluating prevention interventions. We leave to others the tasks of identifying which specific programs are most cost-effective (e.g., Aos, 2010; Aos, Leib, Mayfield, Miller, &Pennucci, 2004; Greenwood, Model, Rydell, &Chiesa, 1998) and raising the question of whether greater public investment in prevention generally is merited (e.g., Miller, Romano, & Spicer, 2000; Weissberg, Kumpfer, & Seligman, 2003).

We write for two audiences: those who know a lot about prevention but not so much about economic analysis and experts in economic analysis who lack substantive expertise about prevention science. For the former, we explain how these alien, almost mystical methods work so well; for the latter, we explain why these powerful, almost majestic methods do not always work so well.

To avoid any misunderstanding, we will state our position explicitly at the outset. We believe prevention interventions should be subject to the scrutiny of economic analysis. However, analysis that seems straightforward in concept can become messy in its particulars. We also believe that dogmatic or formulaic application of economic analysis that does not make common sense adjustments for the practical realities of prevention interventions can mislead rather than enlighten.

The essential premise of economic analysis in the service of public policy is simple: social welfare is maximized through the efficient allocation of resources. In theory, this maximization occurs simultaneously across all choices a society faces, and

efficient allocation means that no person can be made better off without making someone else worse off; this is known as the “Kaldor-Hicks Criterion” (Boardman, Greenberg, Vining, & Weimer, 2006). Cost-benefit analysis is the particular tool solidly rooted in that theory. We will use the adjective “allocative” when we are referring to efficiency in the Kaldor-Hicks sense. In practice many if not most decisions are informed by less ambitious notions of efficiency, for which a range of additional tools become relevant.

In either case, there is general agreement that efficiency analysis should consider *allconsequences* for society that are *caused by* a decision or program within a unified analysis. When considering a single program, the recommendation is a “go” if and only if the *present value* of cumulated effects over time, net of *all costs includingopportunity costs*, are positive. When there are multiple programs, they should be compared on some *common metric*.

Of course, efficiency is not all that matters when making decisions with public dollars. Governments appropriately act for other reasons including justice, national security, and compassion; if a child is trapped at the bottom of a well, we do not calculate the cost of rescue before deciding whether to act. Yet efficiency is widely accepted as an important desideratum, and economic analysis is just a collection of procedures that seeks to support that objective. It is common to say that in these times of budgetary challenges we must pay particular attention to cost-effectiveness, but it is the exception when a society is so affluent as to not care about efficiency.

Nevertheless, economic analysis remains controversial. It has variously been decried as inhuman, irrational, and/or inane. The resistance has two roots: (1) lay misunderstanding of

sensible, albeit esoteric, procedures and (2) hubris among its methodological experts concerning fundamental limitations of its procedures. The five emphasized phrases in the paragraph above account for the bulk of what makes economic analysis provocative for prevention science, in both good and bad ways. So, after an introductory vignette, we organize this discussion around those five themes in the following order: “common metric,” “all costs including opportunity costs,” “present value,” “caused by,” and finally “all consequences.”

25.1.1 Introductory Vignette

It is helpful to connect economic analysis for public policy with that in the business world. Suppose a company had the following option. It could spend $10 million on a marketing campaign that would induce 100,000 people to buy its product. Should the firm proceed?

In order to answer that question, it is necessary to quantify the value of an incremental sale. Suppose the wizards in the accounting department determined that the firm’s profit margin on each sale is $200. Then economic analysis would say “yes,” launch the marketing campaign. At $200 per customer, generating 100,000 more customers is worth $200 * 100,000 = $20 million, and it is sensible to buy something worth $20 million if it only costs $10 million.

Similarly, suppose a public health agency could spend $10 million on a vaccination campaign that would prevent 100,000 cases of flu. Should the agency proceed? It is hard to say because it is not obvious how to value preventing one case of flu. Cases of flu are neither traded on a commodities exchange nor bought at the local mall, so how does one attach a price or value to there being one fewer case of flu?

Economists have grappled with such questions for decades and developed a variety of creative answers. We'll elaborate below, but foreshadow here. One can, of course, ask people about their willingness to pay to avoid an outcome, known as "contingent valuation." If the average person says he would pay up to $200 to avoid the flu, then perhaps $200 is a good estimate of the value to society of preventing a case of flu. But people tend not to be very good at answering hypothetical questions, particularly about things less familiar than the flu. When given the chance to actually spend their own money to avoid an adverse outcome, people often spend much more or much less than what they self-report as their willingness to pay. So economists prefer to base valuations not on mere words, but instead on actions observed from real market transactions or "revealed preference." For example, the amount people spend on burglar alarms provides insight into how much they dislike being burglarized.

Suppose that the wizards in the economics department determine that the relevant population's revealed preferences indicate that it values not getting the flu at $200 per case of flu. If we ignore for now complications such as the possibility of side effects, herd immunity, and the like, then the analysis is the same as that for the for-profit firm and so is the conclusion. The public agency should be willing to spend $10 million in order to prevent the public from suffering $20 million worth of flu.

Thus, economic analysis views averting a cost and generating a gain as equivalent, which is good, because almost by definition most of the benefits of *prevention* programs come from preventing costs, not generating gains. So in this theoretical sense economic analysis does not discriminate against prevention programs. However, as a practical matter, it is much

harder to count events that do not happen, than it is to count events that did happen. We return to the problem of estimating the causal consequences of prevention below.

The examples above were either/or decisions: either launch the marketing/public education campaign or not. In the jargon, those are “go/no-go decisions.” Usually, however, there are more alternatives. For example, suppose the firm or public health agency could consider an alternative initiative, one that costs $25 million but whose reach was 200,000—either new customers for the firm or flu cases averted for the public health agency. The net benefit of this new program is greater because 200,000 * $200 – $25 million = $15 million—which is larger than the $10 million net benefit from the first program. So, given a choice, both the firm and the public health agency should opt for this second initiative because it offers the larger net benefit.

This vignette also illustrates the difference between thinking in terms of net benefits vs. a cost-effectiveness ratio. Someone might object that the original program was more cost-effective. It reached 10,000 people per $1 million, whereas the alternative program’s corresponding ratio is only 200,000 / $25 million = 8,000 people per $1 million. That is true, but irrelevant if the programs as described are the only options available. However, if the original program could be scaled up proportionally, so that by spending $25 million (2.5 times as much as originally proposed) one could reach 250,000 people (2.5 times as many), then it would be preferred because its net benefit would then be 250,000 * $200 – $25 million = $25 million, which is even better than the $15 million net benefit of the alternative program.

Let’s push this example one step farther to highlight an important difference in perspective between the firm and the public health agency. When a firm spends $10 million to make $20 million it ends up with more cash in the bank than it started with. It is a single entity that makes the decision, pays the cost, and receives the benefit. Moreover, all decision makers within the firm have the same objective, to maximize profits, and hence decisions are more easily made.

Things are more complicated for the public health agency. The agency spends from its own budget to create non-monetary benefits that accrue to others. So, unlike the firm, after running a highly cost-effective campaign, it has less cash in the bank (or, more realistically, less spending authority left under its budget). It would be nice if the people who didn’t get the flu expressed their gratitude by writing the agency a $200 check, but they don’t. In reality, these people likely don’t even know they were among the 200,000 beneficiaries who did not get the flu due to the program, let alone know who they should thank for that valuable service. They might mistakenly credit good genes, their personal trainer, or vitamin supplements.

In theory, for countries with governments of the people, by the people, and for the people, we are all one big happy family or “society.” We the society decide, we the society pay, and we the society benefit from the flu prevention campaign, so from society’s perspective, the analysis is equivalent to that for the firm. But, in practice, the world is full of bureaucratic silos and parochial perspectives. Benevolent social planners seeking to maximize social welfare are few and far between; consider that in the entire United States, there are only two government employees who are even charged with looking after the country’s overall welfare (the President and Vice President).

So economic analysis of public policy needs to be thoughtful about from whose perspective the analysis is done. “Society as a whole” is the most common perspective adopted, particularly in academic work, but it is not always the most useful or influential to the extent that it is an abstract ideal, divorced from more tangible priorities of actual decision makers (Elvik, 2010; Humphreys, Wagner, & Gage, 2008). Good researchers often address the problem by evaluating the same program from multiple perspectives (e.g., Lee, Aos, & Miller, 2008).

25.2 The (Elusive) Common Metric

The vignette introduced two broad categories of cost analysis metrics: (1) net measures, which capture the difference between benefits and costs, and (2) ratios of two measures of interest such as cost per benefit (or benefit per cost). The former uses subtraction and the latter division.

The primary advantage of using the difference between benefits and costs (commonly referred to as “net benefit”) is that it makes it simple to apply the Kaldor-Hicks criterion of implementing only those programs for which a net gain is obtained by society. The main drawback of focusing on net benefits is that both terms have to be measured in the same units; as your grade school teacher explained, you are not allowed to add (or subtract) apples and oranges.

The principal benefit of using ratios is that there is nothing wrong with taking ratios of things measured in different units. Every driver understands the meaning of miles per hour and miles per gallon, or their metric equivalent, even though it makes no sense to add two miles plus two gallons. That flexibility is valuable when it is practically or politically difficult to translate one unit into another. If spending $10 million pre-

vented 100 rapes instead of 100,000 cases of flu, then computing the program's net benefit would require defining the value of preventing a rape. Mathematical continuity implies there must be such a number somewhere between $0 and a million times the GDP of the entire world, but that does not mean any government official wants to endorse an analysis that names such a number.

The more common unquantifiable is life. How much is a human life worth? Volumes have been written on the topic, and some experts will argue long and hard that this or that approach is the "right" way to value a human life in cost analyses. Nevertheless, whenever possible the prudent analyst and every politician will compare two life-saving programs in terms of their cost-effectiveness (e.g., lives or life-years saved per $1 million) not on net benefit terms.

The catch is "whenever possible." Suppose one must choose between two crime prevention programs. Each costs $10 million. One will prevent 2 homicides and 10 rapes; the other will prevent 4 homicides and 2 rapes. The first is more cost-effective at preventing rape; the second is more cost-effective at preventing homicides. The ideals of economic analysis compel us to consider all important consequences, and clearly rapes and homicides are both important. So sometimes there is no getting around the need to value disparate outcomes in some common metric.

With that introduction, let us now define the primary performance metrics used in policy analysis by briefly describing the four basic techniques: cost offsets, cost-effectiveness analysis (CEA), cost-utility analysis (CUA), and cost-benefit analysis (CBA). While all of the techniques are used regularly in policy evaluation, and termed as "economic evaluations," only CBA

adheres to the principles of welfare economics and the goal of allocative efficiency, which is why it is the preferred method of economists.

25.2.1 Cost Offsets

Cost offset analysis counts not only costs generated by the program,[3] but also cost savings (or revenue gained) accrued to the agency paying for the program. A classic example would be providing preventive care that obviates the need for more expensive treatment (e.g., screening for hepatitis, so treatment can begin before the disease has progressed). Sometimes the cost offsets (reductions) are bigger than the original program costs, so implementing the program actually saves money. An example of such a program in the drug prevention area is raising the tax on beer to reduce alcohol initiation and/or binge drinking. The cost of imposing or raising the tax on alcohol is more than fully offset by the revenue generated from the higher taxes.

25.2.2 Cost-Effectiveness Analysis

CEA compares ratios of the cost of a program relative to its effectiveness at producing a specific desirable outcome (Drummond, O'Brien, Stoddart, & Torrance, 2005; Gold, Siegel, Russell, & Weinstein, 1996). For example, if the key outcome were overdoses averted, then

[3] We will henceforth use the term "program" to refer to a program, policy, or intervention that might be considered by the government or prevention service provider.

$$CostEffectiveness\ Ratio = \frac{Cost\ w\ Intervention - Cost\ w/o\ Intervention}{ODs\ averted\ w\ Intervention - ODs\ averted\ w/o\ Intervention}$$

Thus, the CEA ratio indicates how much one has to "pay" to "purchase" one unit of the benefit (e.g., cost per overdose averted). Expressed in this format, smaller ratios are better, indicating less expensive ways of purchasing a given benefit. Some literatures prefer the inverse ratio so that larger numbers are better (more benefits purchased per million dollars spent).

CEA measures program desirability in a way that can be compared directly across competing programs but is limited to interventions that produce one primary benefit. In some instances decision makers might only be concerned about the gains in terms of one primary measure of interest (lives saved, students graduating), but for many areas of policy the benefits (or cost offsets) cannot be easily represented along a single dimension. Substance abuse prevention programs represent a perfect example, in that many prevention programs have components that also improve self-esteem and self-advocacy and reduce peer influence thereby reducing delinquency and incidences of unprotected sex and improving rates of graduation (Ellickson, Collins, Bogart, Klein, & Taylor, 2005; Hawkins, Kosterman, Catalano, Hill, & Abbott, 2005; Mensch &Kandel, 1988).

25.2.3 Cost-Utility Analysis

CUA combines multiple benefits into a single aggregate measure when all of those benefits are health related (Drummond et al., 2005). Like CEA, CUA considers the costs and

outcomes simultaneously by forming and comparing ratios. The outcome of interest, however, is expressed in expected utility or general well-being with respect to health, not a single outcome such as averted overdose. Changes in utility are expressed in healthy-year equivalents (HYEs), disability-adjusted life years (DALYs), or, most commonly, quality-adjusted life years (QALYs) (Gold et al., 1996). These metrics all assign a numerical weight to each health state that reflects its desirability, ranging from zero (death) to one (optimal health). Intervention effects are represented as changes in health states, and the quality-adjusted score for each health state is multiplied by the expected time spent in the state and then summed over the expected time of life.

Eliciting preference weightings for health states is difficult. Specialists in this area grapple with issues like the fact that prospectively people think an adverse health outcome (e.g., loss of a limb) will be much worse than do people who have suffered that outcome and have had time to adjust to it. Two widely adopted methods are the healthy days measures (Centers for Disease Control and Prevention, 2000) and the EuroQol-5D (EQ-5D) (Kind, Dolan, Gudex, & Williams, 1998; Rabin & de Charro, 2001). Neither is perfect in its measurement of health states. Furthermore, neither reflects the non-health aspects attributable to prevention, such as reductions in criminal engagement or child neglect associated with drug addiction. Hence, scientists are still working to improve measures of well-being such as the “quality of life index” (QOLI) (Daley, Shepard, & Bury-Maynard, 2005; French, Salome, Sindelar, & McClellan, 2002). Fortunately, as improved measures emerge, they can easily be folded into the same basic analytic framework.

25.2.4 Cost-Benefit Analysis

Prevention programs often improve a range of non-health outcomes in addition to improving health: drug prevention programs might lead to better family relations, improved employment, and less criminal involvement. Other policy domains also recognize that health is not the only relevant criteria. For example, policy analysts evaluating a proposed dam would factor in outcomes such as electricity production, enhanced recreational opportunities, and flood control (including protection of property as well as lives). Hence, other than in the domain of health, policy analysts generally favor CBA as they frequently are forced to consider multiple, distinct outcomes. Like CUA, CBA attempts to convert all outcomes into a common metric, but in this case, the common metric is currency (dollars in the United States, euros in the Eurozone, etc.) rather than the desirability of health states.

Just as with CUA, there is a literature devoted to determining how to assign reasonable values to various outcomes. For example, what is the societal cost of a burglar stealing something? The old answer was zero on the grounds that theft merely transfers wealth from one person to another, with no net loss to society. However, the public and policy makers accountable to the public vehemently object to the idea that there is no social cost to property crime. The more modern approach is to focus on the “willingness to pay” (WTP) to avoid such criminal victimization. That is, if an average person were willing to pay $1,000 to avoid being burglarized, then preventing a burglary should be valued at $1,000.

Likewise, for violent crimes, the older approach focused on victims’ hospital bills and days of work lost while recuperating, but this led to valuations that struck the public as absurdly low.

Estimates based on jury awards and WTP principles that incorporate the "intangible" costs of pain and suffering are much higher.[4]

One might think crime costs are important for law enforcement interventions but a digression for prevention. However, crime is so costly to society that its prevention can account for an important part of the justification for interventions that have nothing directly to do with policing. For example, they account for half of Lee et al.'s (2008) estimated benefits of nurse home visits for low-income families expecting their first child. In the area of substance abuse prevention, crime is consistently the second largest component of the social cost of alcohol and drug abuse (Harwood, Fountain, & Livermore, 1998; Office of National Drug Control Policy [ONDCP], 2004).

The classic imponderable is how does one value a human life? The contentious human capital approach values human life based on the present value of expected future earnings (Rice & Cooper, 1967); that values the lives of those with high-paying jobs more than those of individuals who choose not to work (e.g., stay-at-home parents) or who earn lower wages. The WTP approach gets around this issue by calculating the value of a statistical life (VSL) based on purchases people make to reduce their risk of death, or premiums they must pay to accept additional risk of mortality, and applying the same rate to all people in that society (Schelling, 1968; Viscusi&Aldy, 2003). Examples of such transactions include the purchase of safety devices (e.g., cars with airbags, home security systems) and wage premiums for working in risky jobs (e.g., mining or construction).

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[4] Cohen (2005) and Miller, Cohen, and Wiersema (1996) are standard references for the valuation of crimes prevented.

Before sighing in relief at this apparently successful evasion of distasteful inequity across income groups, note that applying the same value to all lives lost automatically assigns a much lower value to a year in the life of someone who would have died young (e.g., prevented drug overdose) than in the life of someone who would have died when older (e.g., prevented death from seasonal flu). Conversely, applying the same value to all life years lost automatically assigns a lower value to deaths of older people than of younger people. Considerable attention has been devoted to the impact of age effects in analyses of VSL by economists, with results showing how VSL and age depend on how well capital markets function (Aldy&Viscusi, 2000; Johansson, 2002; Shepard &Zeckhauser, 1984).

Don't let jargon and acronyms lull one into thinking that economic analysis is value free. In reality, seemingly minor technical choices by the analyst, such as the choice to value outcomes in terms of life years rather than lives lived, do involve valuation judgments that indeed can affect which program comes out the winner in an economic analysis.

A benefit of particular relevance to prevention sciences whose quantification is in nascent stages is prevention of drug dependence.[5] There are health problems correlated with dependence for which estimates have been made, including hepatitis, depression, and living with AIDS. But imagine a person who is in perfect health except for being dependent on cocaine. QALY losses are routinely considered for other psychiatric disorders. Dependence is a recognized medical condition, and most people would view drug dependence as a state

[5] Another is the psychological pain and suffering of family and friends of those who are addicted.

with a lower quality of life than being in perfect health and not being dependent; the cravings, obsessing about obtaining the next dose, and general loss of control adversely affect daily functioning, just as surely as would other ailments. But the social cost of dependence per se is rarely included in economic analyses.

Rough calculations suggest this omission could be problematic,[6] but many economic analyses still assume that even dependent users are like conventional consumers in the sense that the satisfaction derived from consuming a product (drugs in this case) can be assumed to exceed its purchase price; otherwise, the person would not have consumed it. By that logic, not only could there be no cost of dependence, one should actually count drug use as a benefit, so preventing use creates a negative benefit (for our purposes, a cost).

Intoxication, as distinct from dependence, presents a similar challenge. The economic costs of alcohol use are large; one frequently referenced figure is $185 billion in the United States in 1998 (Harwood, 2000). Americans now consume on the order of 100 billion standard drinks per year, meaning 0.6 ounce servings of alcohol whether in the form of 12 ounces of beer, 5 ounces of wine, or 1.5 ounces of spirits (Cook, 2007). Someone morally opposed to intoxication might assign a social cost of a few dollars per drink while an economist committed to

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[6] Some authors assign a loss of 0.1 QALY per life year spent drug dependent (Stouthard et al., 1997), and that seems consistent with one of the few empirical studies (Pyne et al., 2008). ONDCP (2004) estimates there were 2.7 million “hardcore” cocaine users in the United States in 2000, suggesting a loss of 0.27 million QALY per year from cocaine dependence. A traditional but dated valuation is $65,000 per QALY (e.g., French et al., 2002), but updating with more modern estimates of the value of a life (e.g., Viscusi and Aldy’s 2003 valuation of $4–$9 million per life) suggests valuations closer to $250,000 per QALY. So the cost of cocaine dependence itself, as distinct from its sequelae, could be on the order of $17–$70 billion per year, which is not small compared to the cost-of-illness study estimates of drug-related costs (e.g., Harwood, 2000).

valuing material pleasures might assign a benefit of a few dollars per drink. If either valuation of alcohol consumption and intoxication (the negative or the positive) were used in calculating the efficiency of alcohol prevention interventions, it would loom quite large in the analysis.

Likewise, Kilmer, Caulkins, Pacula, MacCoun, and Reuter (2010) estimated various budgetary consequences of California's narrowly defeated proposition to legalize marijuana. Many outcomes that attracted considerable attention in the debate had magnitudes of $5–$200 million per year. Yet Kilmer et al.'s (2010) figures suggest current consumption in California is roughly 1 billion joints per year, a level they judged could plausibly have doubled with legalization. So for someone assigning a benefit or a cost to the increased marijuana consumption, whose absolute value might be $1 or more per joint consumed, the monetized value of increased intoxication dwarfs the more commonly discussed outcomes.

Resolution of these issues awaits further research, but the discussion illustrates two important points: (1) reductions in use and dependence may be an important contributor to the benefits of prevention programs, in at least some observers' eyes, if they are not dismissed summarily on theoretical grounds and (2) quantification of benefits may inevitably be more nebulous and more controversial for prevention programs than for firms, particularly in domains for which the public believes that the activity itself, not just its consequences, are a matter of public concern.

25.3 All Costs Including Opportunity Costs

The previous section makes clear that monetizing benefits can be tricky. One might think that monetizing program costs

would be a breeze. That may be true by comparison, but only by comparison. A surprising number of complications arise just in quantifying costs. Many stem from the intersection of two facts: (1) prevention evaluations usually take a societal not an agency perspective and (2) many of the resources employed are donated in kind, not purchased.

Analysis of private-sector investments is simpler. For the most part, business analysts only care about outcomes that affect their company, so they do not worry about tracing out indirect or spillover effects. And, few people make charitable donations to for-profit companies. So almost all resources consumed come with a "purchase receipt" (payroll records in the case of "purchasing" employees' time). We do not mean to belittle the hard work of MBAs; they do face complications, such as how rapidly one should depreciate a capital asset. But it is a lot easier to figure out what something is worth if it is bought and sold in arm's length transactions.

Contrast that with, say, a mentoring program that matches adult volunteers with at-risk youth. The most valuable resource consumed is the donated volunteers' time. The conventional approach assigns a shadow or opportunity cost to those hours, such as the wage of professionals providing similar services or the wage of the volunteers themselves in their primary employment. The argument for doing it this way is that societal resources are inherently limited, and when they are used for one purpose, they can no longer be used for another. So the wage the volunteer could have earned doing a similar job represents the opportunity cost of his or her time and is the true economic value of the labor. But those wages could be very different when a corporate lawyer volunteers to read to children in a daycare program than when a social worker volunteers.

One could argue instead that volunteers must be deriving positive net utility from their participation; otherwise they would not have volunteered. Indeed, one could go a step farther and conjure up arguments that society is better off when citizens become involved in one another's lives, so the volunteer hours not only benefit the volunteers and children, but also create a broader set of positive externalities. How to reconcile such divergent views is not something even considered by Fortune 500 companies' investment strategies because they are irrelevant, but specific views on how to value these resources could directly influence whether mentoring programs are viewed as among the most or the least cost-effective forms of prevention.

Similarly, many media-based prevention campaigns employ donated air time, school districts donate facilities to after-school programs, and they donate not just classroom space but also classroom time to school-based programs. (Classroom space is donated in the sense that most prevention programs do not write checks to the school district to "rent" the classroom, the way a corporation rents a conference facility to host a corporate training event.)

To underscore how complicated this can be, consider the Drug Abuse Resistance Education (D.A.R.E.) program, whose curriculum is delivered in schools by police officers. The schools donate space, the police donate the instructor's time, and the nonprofit organization D.A.R.E. America donates the curriculum materials—at least for the first year. Donations raise few challenges for analysis undertaken from the perspective of a single agency (e.g., a public school district); for the agency, costs are mostly reflected in net cash flow and donations do not show up in the flow of dollars.

Usually, however, prevention interventions are evaluated from a societal perspective, and society values the donated resources even if the agency administering the prevention program does not have to purchase them explicitly. When the National Highway Traffic Safety Administration (NHTSA) does a CBA of installing air bags in cars, it counts the cost of the airbags (reflected in the higher price of new cars) not only for the few cars the agency purchases for its own purposes, but for all new vehicles purchased in the country. In effect, car buyers are donating the money that funds the improvement in vehicle safety, and NHTSA rightly recognizes that as a cost to society, even though it never shows up in the agency's budget.

The same line of reasoning applies to a range of unfunded prevention mandates, including motorcycle helmet laws, zoning ordinances that reduce the risk of fires, and many Occupational Safety and Health Administration rules.[7]

So, from a societal perspective, it doesn't matter who bears the costs or donates the inputs because everything is accounted for. Standards are emerging governing how to value various tangibles, such as facility space, but the elephant in the room is valuing the time of the prevention intervention's target audience. Caulkins, Everingham, Rydell, Chiesa, and Bushway (1999) find that the opportunity cost of giving youth a school-based prevention program, instead of using that classroom time to teach conventional academic subjects, dwarfs the budgetary costs for program materials and training that are the traditional focus of cost estimates (e.g., Drug Strategies, 1996). They suggested valuing those classroom hours at

[7] We spend enough time in airports to wonder if the cost to bystanders of exposure to incessant inane warnings about the approaching end of the moving sidewalk generates stress-related mental health problems that more than offset any benefits from prevented moving sidewalk falls.

the average cost of providing secondary education but noted that could be conservative inasmuch as most voters believe public education is a good use of taxpayers' dollars, meaning the benefits of education exceed the cost. Others might argue that students' time has no value because they are too young to earn a wage in the labor market or that the teacher's salary is a better surrogate. We do not want to delve into the pros and cons of each of these approaches. Rather, our point is that thoughtful people can disagree, and the consequences of their choices can matter enormously.[8]

An interesting corollary is that sometimes the traditional objects of cost data collection can be ignored, if it can be shown a priori that they will be swamped by other factors. There is no sense estimating the cost of program materials to the penny if such precision will be swamped by uncertainty about how to value the opportunity cost of using class time for a prevention intervention.

Although generally not discussed, one could raise similar questions about other prevention modalities such as "midnight basketball leagues" (more formally, sports-based community prevention). Even leaving aside the considerable challenges of estimating benefits (c.f., Hartmann &Depro, 2006), what are the costs? If the courts already exist and would otherwise be idle (so no meaningful opportunity cost for facilities) and the adults are not paid staff but volunteers who enjoy shooting

[8] An interesting corollary is that a comprehensive evaluation of school-based programs ought to assess effects on academic outcomes. Consider two programs that involve the same number of classroom contact hours and the same (minor) out-of-pocket costs. The first has zero academic value but reduces drug use by some amount. The second reduces drug use by only three fourths as much but produces half as much general education benefit as the academic classes displaced by the prevention program. The second program would lose if the analysis considered only the effects on drug use and those on general education were ignored, but it would win in a more comprehensive economic analysis.

hoops and spending time with kids, decisions about valuing people's time could well dwarf the tangible budgetary costs for some fliers and a few basketballs.

If government oversight agencies allow methodological latitude in how analyses value donated time and other resources, the door is wide open to the nonprofit world's equivalent of corrupt creative accounting practices. But if oversight agencies tightly prescribe the accounting rules, they risk distorting incentives. For example, if an agency were held firmly to the principle that the opportunity cost of volunteers' hours must be valued at their outside wage, that would create perverse incentives to reject highly educated volunteers because they are more costly. For example, a midnight basketball league could suddenly appear to be extremely costly if an NBA star decided to volunteer.

25.4 Present Value

One of the most common acronyms in economic analysis is NPV (net present value). Policy analysts of all stripes agree that, if the costs and outcomes do not occur at the same point in time, they must be "discounted" back to their "present value." Discounting—or the failure to do so—can be particularly consequential when evaluating prevention interventions because there can be very long lags between program spending and program outcomes. Running a teen smoking prevention program today may prevent a cancer death 50 years down the road.

With money, it is easy to see that a dollar or euro today is not the same as a dollar or euro tomorrow, let alone in 50 years. Normally a given amount of money today is worth more than

the same amount in a year because if we had the money today, we could invest it and have more money in 12 months.

In particular, it is common to assume that a dollar today is worth (1+r) dollars next year and $(1+r)^n$ dollars in *n* years, where *r* is the annual rate of return on available investments. Conversely, a dollar in *n* years is worth only $(1+r)^{-n}$ dollars today. Because the rate of return is (essentially) always positive, $(1+r)^{-n}$ is always less than 1, so money in the future is worth less than the same amount of money today. Hence, to translate dollars in the future into dollars today, we "discount" the future dollars back to their "present value."

So far this sounds interesting only for those who sport green eye shades, a mere technocratic adjustment. What makes discounting controversial is that it is, and in fact should be, applied to non-dollar outcomes, including such sacred things as lives saved. This is a strange concept whose name creates a public relations nightmare. If one asks, "Should we discount future lives?" anyone with a whiff of common sense would say, "Of course not." But he would be wrong. Keeler and Cretin (1983) prove that we must discount non-dollar outcomes and at exactly the same rate; failing to do so can lead to bad decisions, wasted funds, and lives not being saved.

The gist of their argument is captured in the following thought experiment. Suppose we have the option of funding a wonderful prevention intervention; for every $100,000 we invest today, we will save one life in 10 years. (To keep things simple, suppose the program is politically popular, generates no adverse indirect effects, etc.) That opportunity—call it Option A—would generally be thought of as a terrific bargain, and any reasonably affluent society would wish to fund it.

Now most programs that can be run today could just as well be run the following year. So presumably we also have the option—call it Option B—of spending $100,000 in 12 months and thereby saving one life 11 years from now. One way to implement Option B would be to put $97,000 in the bank, let it earn 3% interest over the next year, and then withdraw it to pay for the program.

If we do not “discount” the future lives saved, the choice is easy. Option A lets us save one life for $100,000, but Option B saves the same number of lives for only $97,000. So clearly we should choose Option B; it costs less. Or, assuming these interventions are scalable, we might spend $100 million on Option A today and save 1,000 lives, or we could put $100 million in the bank for a year, use the proceeds to invest $103 million in Option B next year, and thereby save 1,030 lives. Either way, Option B wins.

Of course if we put the $100 million in the bank, then 12 months later we will realize there is an Option C. Namely, leave the money in the bank for another 12 months, letting it accrue further interest until we spend it 24 months later to save even more lives. And so on, ad infinitum.

So we have a paradox. No matter how cost-effective a prevention program is, if we do not discount future nonmonetary benefits, we will always do nothing, preferring to put the money in the bank, saving for a future investment that it is never optimal to make.

Surely if we are impatient and prefer to have our money today, we ought to feel the same urgency about preferring to save lives now, rather than dawdling, but unfortunately this natural impulse to want to implement life-saving measures sooner rather than later gets translated in the emotionless jargon of

economics into the cold-hearted phrase, “discounting the value of future lives.” Perhaps no phrase does more to discredit the entire enterprise of economic analysis, but its roots are entirely humanistic. It is merely the logical consequence of insisting that we be as inpatient in our desire to save lives as we are in our desire to receive money.

Even after one gets comfortable with the idea of discounting future outcomes, there remains the question: What discount rate should be used? When a company assesses investment opportunities with discounted cash flow analysis, it is generally accepted that future outcomes should be discounted at its WACC or weighted average cost of capital. That is essentially its cost of borrowing money. If the business would raise cash to make an investment by taking out a bank loan at 8% interest, then it ought to use an 8% discount rate in its analysis. In a typical situation of an upfront investment generating positive cash streams in the future, this makes the usual go/no-go decision rule (“proceed if discounted benefits exceed discounted costs”) equivalent to “invest in your own operations if the internal rate of return exceeds the interest rate on the loan that could be used to finance those operations,” an eminently sensible approach.

But public agencies do not usually fund prevention programs by taking out bank loans, so what discount rate should they use? This crucial question was debated vigorously in the 1960s and 1970s, when economic analysis was first commonly applied to public investments. The resulting literature is enormous, provocative, carefully reasoned, and ultimately inconclusive. For example, there have been heated debates about whether it matters if the benefits accrue to a different generation of people than those paying the bills, whether one should pay attention to the likelihood that future generations

will be more affluent than we are today, and whether one should inflate discount rates when outcomes are uncertain. Had you asked three smart and well-trained economists in 1980 what discount rate to use you might well have received four answers.

The tendency over the last few decades has been for literatures to just pick some value and stick with it—the benefit being that it improves comparability across analyses. Indeed, one recent contribution to this literature is delightfully entitled "Just Give Me a Number!" (Moore, Boardman, Vining, Weiner, & Greenburg, 2004). For example, the Office of Management and Budget advocates using a "real" rate of 7%, and the classic reference for economic analysis of healthcare interventions (Gold et al., 1996) suggests doing the analysis twice, once with a 3% and once with a 5% discount rate to see whether the results are robust with respect to this parametric choice.[9]

This détente is not fully satisfactory for two reasons. First, while in many domains it does not usually matter whether one uses a 3%, 5%, or 7% discount rate, for prevention program whose gains are far off in the future while the costs are immediate, simple arithmetic shows that those seemingly small distinctions can have very large impacts.

Suppose, for the sake of argument, that we are willing to fund any prevention program whose cost-effectiveness, in present value terms, is at least one life saved per $2 million spent. And, returning to the example with which we opened the sec-

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[9] Fortunately concerning the odd-sounding distinction between "real" and "nominal" discount rates, naïve impulse aligns with logic; we should focus on the "real" rates, meaning the rate after adjusting for inflation. For example, if the actual or "nominal" interest rate is 10%, but inflation is running at 3% per year, then the "real" interest rate is only 10% – 3% = 7%.

tion, suppose that spending $100 million on teen smoking prevention programs today would prevent 1,000 cancer deaths 50 years down the road. Discounting at 3% vs. 7% decisively alters the program's cost-effectiveness. With a 3% rate, the cost per (discounted) life saved is only $400,000, readily meeting the efficiency test, whereas with a 7% discount rate the cost rises to $3 million, and the program would not be approved.

When benefits accrue within a shorter time frame such as five years, the choice of discount rate matters, but not enormously. Moving down (up) from a 5% to a 3% (7%) rate increases (decreases) the cost-effectiveness ratio by a factor of 1.1. But over the longer time horizons that arise routinely for some prevention interventions, discounting generally and the choice of discount rate in particular become tremendously consequential choices.

Second, there is now clear evidence that individuals do not apply a constant discount rate over time as in standard "exponential" discounting. They might discount in another way, such as by "hyperbolic" discounting (Laibson, 1997).[10]There is evidence that societies do as well (Henderson & Langford, 1998). Some suggest this is normative, not just descriptive, and calls for hyperbolic discounting to be done in economic evaluations because the social discount rate should in some sense reflect an aggregation of individuals' (heterogeneous) time preferences (e.g., Nocetti, Jouini, &Napp, 2008). This has become an active topic of discussion in part because traditional exponential discounting discourages taking action to prevent global

[10] What exactly hyperbolic discounting means is not important here, but for those not familiar with the term it essentially means dividing by (1+rn) rather than $(1+r)^n$, albeit for a different value of *r*. The key point is that for outcomes in the medium to distant future, the distinction between hyperbolic and exponential discounting is highly consequential.

warming (Karp, 2005). Drug and violence prevention advocates should cheer on environmentalists in this regard, but for the time being, the state of the art is applying one somewhat arbitrary but conventional per-period discount rate to all time periods.

25.5 Caused By

Perhaps the least controversial bedrock principle of economic analysis is that only those consequences that are caused by a prevention program should be stacked up against its costs. In many disciplines establishing causal connections is not controversial. The rules of Newtonian physics are so powerfully predictive that no one argues about what causes billiard balls to move. In others—including much of clinical medicine—we believe in causality if and only if it has been demonstrated via a randomized clinical trial (RCT).

RCTs in social science are becoming increasingly common, in light of the early successful trials in healthcare insurance (Newhouse, 1993), poverty (U.S. Department of Health and Human Services, 2010; U.S. Department of Housing and Urban Development, 2003), and criminal justice (see Farrington &Welsch, 2005, for a review). RCT studies play an important role for many prevention interventions, but they are not practical in others. Consider the very important domain of preventing war, which includes an idea called “democratic peace theory.” Roughly speaking, the hypothesis is that democracies rarely if ever go to war with each other, from which some might extrapolate the idea that spreading democracy causes peace.

Is it reasonable to expect proponents of democratic peace theory to bolster their beliefs with evidence from an RCT? It is

not clear whether institutional review boards would sanction randomly assigning the people in some countries to receive democratic representation and others to live under dictatorship, or who would have the authority to implement the randomization, let alone how to keep the whole experiment double blind.

This example is, of course, extreme, but there are environmental prevention interventions for which random assignment would be just as infeasible.[11] Consider the idea of using source country control, precursor chemical regulations, and/or border interdiction to keep illegal drug prices high and thereby prevent drug use. Billions of dollars are invested in such strategies every year in the face of active, sometimes acrimonious debate about effectiveness, and there is no realistic possibility of resolving the debate via RCTs. Indeed, RCTs are often hard to achieve for *policies*, as opposed to *programs*, and even for programs when the unit of analysis is the city or larger, as opposed to the individual, classroom, or neighborhood.

Hence, analysts have developed a suite of quasi-experimental methods for assessing the extent to which a program or policy causes one or more outcomes when RCTs are not possible, including propensity score methods, instrumental variable

[11] Return on investment language, if not calculations, does appear in discussions of conflict prevention, as in this quote from *New York Times* columnist Nicholas Kristof (2011): “Sometimes foreign aid and diplomacy constitute a good investment, earning a strong return—and I would argue that that is the case with support for South Sudan. If South Sudan falls apart, we’ll end up spending billions and billions of dollars in coming years and decades dealing with humanitarian and other catastrophes. Isn’t it smarter — as well as simply the right thing to do—to help it stand on its feet in the next couple of years? Indeed, I would argue that the very modest sums we’ve invested over the last few years in Sudan diplomacy appear to have averted a new war, at least so far—and one estimate is that the average African war imposes economic costs of about $100 billion. Not a bad return.”

techniques, difference-in-difference estimation, and regression discontinuity approaches. It is beyond the scope of this paper to describe them, but see Rosenbaum (2010) or Angrist and Pischke (2010) for a review of these methods, their strengths, and their limitations.

While quasi-experimental methods are generally viewed as second best, it is important to remind readers that even the gold standard RCT can also get tarnished in at least two ways. The first is external validity. Typical concerns pertain to selection effects associated with getting into the data set. A famous controversy pertains to the Life Skills program. Effects in schools that implemented the program with high fidelity were impressive (Botvin, Baker, Dusenbury, Botvin, & Diaz, 1995), but some argue that an intent-to-treat rather than treatment-on-the-treated perspective would be more informative regarding economic returns that could be expected from future investments in the program (Gorman, 2002).

We think it is also instructive to remember the case of the Cyclops light or, more formally, center high mounted stop lamps (CHMSLs), even though the original experiments were not RCTs (Kahane& Hertz, 1998). CHMSLs, or third brake lights, have been required on all passenger vehicles sold in the United States since 1986. Before the regulation was promulgated, three experiments were conducted with fleets of taxicabs and corporate cars; all yielded roughly 50% reductions in rear-impact crashes in which the lead car was braking, which is roughly twothirds of rear-impact crashes. Yet the first study conducted after nationwide implementation found reductions of only 15% and the news kept getting worse. A year later the estimated reduction was only 11.3%. Within a decade, it had fallen to 5%, a full order of magnitude smaller than initial studies found. There was nothing wrong with the early studies.

However, before nationwide implementation, CHMSLs were novelties that attracted the attention of other drivers; 10 years later, people were so used to cars having third brake lights that the novelty effect had disappeared, leaving only the much smaller long-run effect. CHMSLs are so cheap that they remain a cost-effective way of preventing crashes, but the episode offers a poignant example of how even a perfect trial may vastly over- (or under-) estimate the true causal effects of a prevention intervention at scale.

A second limitation arises when effects on proximate outcomes are solidly grounded in RCTs, but economic analysis requires estimates of effects on other, longerrun and/or more distal outcomes. As Caulkins (2002, p.488) observes for school-based drug prevention:

> [T]here are clearly stated confidence intervals around empirical estimates of the programs' impact on participants' self-reported marijuana use through 12th grade. The real benefits, however, come from actual (not self-reported) changes in the use of all substances (not just marijuana) throughout the lifetime (not just 12th grade) of all people affected by the program, including spillover effects (not just reductions in use by people in the program). Uncertainty concerning how to extrapolate from the empirically measured evaluation outcomes to the outcomes of interest to a policy analyst dwarfs uncertainty concerning the magnitude of the measured effects.

That is, economic analysis sometimes requires projecting or modeling results for which suitable data have not been collected in the past. Modeling is common in engineering. Space scientists do not estimate how much fuel a rocket will need by collecting data on how much fuel rockets used in the past and running a regression; they build a model of the rocket's dynamics from first principles, such as Newton's laws of motion. Individual people are rarely as predictable as rockets, but sometimes they behave predictably in aggregate. For example, models of infectious diseases may help predict how certain interventions will affect the spread of hepatitis or HIV (Kaplan, 1995; Pollack, 2001, 2002).

Stepping back from rarified debates about what are and are not proper analytic approaches to establishing causality, there are also more pedestrian challenges. For example, federal prevention grants to states may be disbursed to a large number of agencies running a heterogeneous range of interventions. Each program might be so small that adding outcomes evaluation would cost more than the program itself, but aggregating across programs may be impossible if the programs are unlike. This sometimes leads to a strategy of merely verifying adherence to a model program approach vs. directly assessing effects and implicitly assuming that the economic performance achieved by the documented model program applies to the present population. Such extrapolation is dangerous even if the model program were evaluated by a rigorous RCT.

Recognition of the limitations of individual trials—even RCTs—has given rise to the ideal that policy should be grounded in systematic reviews of multiple studies; examples include Cochrane reviews such as Foxcroft, Ireland, Lowe, and Breen (2002) or Thomas and Perera (2006). But even systematic reviews have limitations (Mullen &Ramírez, 2006); as McCambridge (2007) and others argue, reporting biases can influence what results get published in peer-reviewed journals. Furthermore, policy encompasses a broad range of questions and interventions, but systematic reviews tend to focus on effect size, not optimal design considerations, and the bulk of scientific evidence that meets strict review criteria may pertain to one of a few modalities. For drug prevention, evaluations of school-based programs predominate. Faggiano et al.'s (2008)Cochrane review of school-based programs included 32 studies vs. only 17 for all non-school modalities combined in Gates, McCambridge, Smith, and Foxcroft's (2006) review. Likewise, for harm prevention interventions, the

literature on syringe exchange and safe injection facilities exceeds that of all other interventions combined (Ritter & Cameron, 2005).

25.6 All Consequences

Naturally economic analysis seeks to associate with a program all of its consequences. This effort entails an understanding of what and who is affected. Sometimes that is easy. When treating an individual's cancer, it is reasonable to presume that all of the resulting health benefits will accrue to the patient and, perhaps, to the patient's family. That circumscribes the range over which effects measurements need to be taken.

With prevention interventions, it is the norm not the exception for indirect or spillover effects to be too large to ignore. That is obvious with contagious disease. Preventing one person from becoming infected with HIV might avert more than one HIV infection if the individual receiving the prevention intervention would otherwise have infected others who in turn could have infected still others. In short, there is a "social multiplier" effect that a comprehensive analysis should recognize.

Including social multiplier and other spillover effects is not always easy. An epidemic's reproductive number varies not only by infectious agent, but also by stage of the epidemic and the larger social context. And the challenges multiply when the physics of diffusion are less mechanistic. Not only literal pathogens, but also drug use could be "contagious" in the sense of spreading from person to person (Brill & Hirose, 1969; Caulkins, 2005; Ferrence, 2001). Adoption of drug use can be seen as a form of new product adoption, something markets have studied with models very similar to susceptible-

infected-recovered (SIR) epidemiological models at least since the work of Bass (1969), and similar thinking applies to other behaviors, even urban legends (Noymer, 2001).

That social interactions can create indirect effects does not mean that it is easy to estimate them from the data. Great excitement surrounded the idea that obesity might be contagious (Christakis & Fowler, 2007), but great humility followed the discovery that similar analytic methods found acne, headaches, and height to be similarly contagious (Cohen-Cole & Fletcher, 2008).

Spillover effects can be even less direct. Blumstein and Cork (1996) make a convincing case that crack use spawned street markets that created “jobs” for youthful dealers, giving those adolescents the means and incentive to arm themselves. That arms race amplified the lethality of everyday disputes over slights and reputations and girlfriends that might previously have been settled with fists or knives. So it is entirely plausible that some demand-side intervention, whether prevention- or treatment-oriented, that successfully reduced use and consequently, drug-selling and thus arming and thus shooting, could have prevented some homicides. The precepts of economic analysis demand that all consequences be considered, but it is often not plausible to capture such indirect effects at all, and certainly not to the same standards as the direct effects experienced by program participants.

The technical jargon for this is *ambiguity regarding system boundaries*. Conceptually one wants to draw a dotted line around the system an intervention is targeting and measure all relevant outcomes for everything and everyone within those dotted lines. But prevention interventions, particularly drug and crime prevention interventions, are intervening in lives

that are intertwined with others in the complex fabric of social interactions. The judgment inherent in deciding what effects can reasonably be estimated and which are so speculative and indirect as to require omission creates abundant opportunity for bias in evaluations, conscious or otherwise. Particularly given how often prevention interventions are evaluated by the entrepreneurial researchers who invented them, there is a temptation to include indirect benefits and exclude indirect costs.

8.7 Coda: The Goldilocks Principle for Economic Analysis in Prevention Sciences

We began with what appears to be an uncontroversial assertion. Allocation of taxpayers' dollars across programs should be informed by economic analysis that considers *allconsequences*for society that are *caused by* a program, with options ranked based on some *common metric* that reflects the *present value* of cumulated benefits net of *all costs includingopportunity costs*.We then marched through those five emphasized phrases pointing out how muddy this can become in practice, particularly in the context of prevention. Hence, when seeking the ideal role of cost analysis in prevention policy, we suggest turning to the wisdom of Aristotle and Goldilocks. In the latter's spirit, we might think of three positions, albeit in stylized caricature.

In the bad old days prevention was not held accountable by cost analysis. We funded and researched and implemented on faith because "kids are worth it" and "an ounce of prevention is worth a pound of cure." Those were—and to the extent that the era hasn't fully passed still are—bad days for taxpayers. Lots of money and time have been squandered on programs whose performance just doesn't withstand scrutiny. But

an even bigger misallocation may stem from funding programs that are effective, but relatively inefficient, because even more lives could have been saved by shifting those funds to programs that were still more cost-effective.

Times have changed. Policy domains that were once seen as beyond quantification are now routinely subjected to economic analysis, and those who still object have been relegated to a shunned fringe. The triumphant or barbaric sweep—depending on one's perspective—of economic analysis has moved from such traditional domains as defense, transportation, and flood control to tackle less quantifiable issues in environmental, health, and safety regulation and beyond, so by now any implicitly acknowledged exception for prevention is disappearing. Prevention investments are being subjected to the same brutal calculus as are other programs.

Is the pendulum swinging too far? Economic analysis is always harder in practice than it is on the chalkboard, but to the extent that the issues outlined above make its abstractions particularly problematic for prevention programs, one might say we have moved from the bad old days of no evaluation to the bad current days of rigidly formulaic evaluation.

We look forward with guarded optimism to a golden future of Aristotelian moderation. One that requires economic analysis of all prevention efforts, but which recognizes as even Arrow et al. (1996) do, that although benefit-cost analysis is useful, it is neither a necessary nor sufficient basis for public decision making. So, in their words (1996, pp.221–222), "*Although agencies should be required to conduct benefit-cost analyses for major decisions and to explain why they have selected actions for which reliable evidence indicates that expected benefits are significantly less than expected costs, those agencies*

should not be bound by strict benefit-cost tests. Factors other than aggregate economic benefits and costs, such as equity within and across generations, may be important in some decisions" [emphasis in original].We would add that some license be given for adapting the methods to the peculiar exigencies of prevention. For example, varying the social discount rate within the range generally viewed as reasonable can decisively affect the outcome of analysis for prevention programs whose effects occur decades in the future.

Admittedly, this is a caricature. The idea that prevention should be subject to economic analysis is hardly new (c.f., Plotnick, 1994). And even today the most widely implemented school-based drug prevention curriculum, D.A.R.E., is one for which evidence of effectiveness let alone cost-effectiveness is weak at best (Kanof, 2003). But we have a sense of pendulum swings and at this point worry as much about dogmatic faith in mechanical application of economic analysis as we do about dogmatic faith in funding prevention without asking whether such spending is justified. And we look forward to a time when all prevention investments are accompanied by quantitative projection of costs and benefits produced and interpreted by people who are rooted in the prevention field and its special circumstances.

What might that involve? In part, just waiting. Scientists from a number of disciplines are already working hard to tackle many of the issues we identified above, in part because they are not unique to the prevention sciences. Methodological progress is particularly rapid for identifying causal relationships between programs and their many consequences, especially those intangible consequences such as preventing lost quality of life among dependents and their families. We can also expect progress on understanding the full range of costs, including

the opportunity costs of volunteers and participants, and progress on how to value outcomes in comparable terms regardless of their form or when they occur.

It would be a mistake, though, to imagine the challenges are primarily technical, in the sense of just needing a new and fancier statistical method. The challenges are at least as much contextual and cultural; the field needs more people who are fully bilingual in economic analysis and prevention science.

We would also suggest that the greatest contributions will come when economic analysis is harnessed to produce insights, not just winners in a cost-effectiveness horse race. Classically economic analysis sells itself as promoting efficient use of scarce resources (e.g., taxpayer money) by determining which programs ought to be funded at all and which ought to be funded first. And in theory economic analysis can compare the benefits of prevention programs across target behaviors (e.g., comparing a drug prevention program to one that prevents obesity or promotes vaccination). Yet even that is still just picking winners from an existing stable. Economic analysis has the potential not only to identifywhich programs are winners, but *why they are winners*—in the sense of showing which benefits and costs are the most important, and which are secondary—and, hence, to provide insights that can inform the design of future generations of programs.

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