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Substance misuse prevention and economic analysis: Challenges and opportunities regarding international utility

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Abstract

Economic analyses of substance misuse prevention assess the intervention cost necessary to achieve a particular outcome, and thereby provide an additional dimension for evaluating prevention programming. This paper reviews several types of economic analysis, considers how they can be applied to substance misuse prevention, and discusses challenges to enhancing their international relevance, particularly their usefulness for informing policy decisions. Important first steps taken to address these challenges are presented, including the disease burden concept and the development of generalized cost-effectiveness, advances that facilitate international policy discussions by providing a common framework for evaluating health care needs and program effects.

Keywords

Economic analysis; Cost effectiveness; Cost utility; Cost benefit; Prevention; Alcohol; Drugs; Substance misuse; Policy; International

Misuse of substances such as alcohol, tobacco, and licit and illicit drugs constitutes a major problem across the world. As indicated by the criteria associated with positive diagnoses of substance use disorders, substance misuse can lead to a variety of negative outcomes, including an enduring decrease in social and occupational functioning as individuals give undue priority to their substance use (American Psychiatric Association, 2000; World Health Organization, 1992). The impaired functioning, greater morbidity, and early mortality experienced by those who misuse substances can collectively be defined as the disease burden of substance misuse, and can be quantified in terms of disability adjusted life years (DALYs), or the number of years of fully functional life lost (e.g., Fox-Rushby & Hanson, 2001). In the report of the World Health Organization's (2009) Comparative Risk Assessment update for 2004, alcohol, tobacco, and illicit drugs together accounted for 12.6 percent of deaths worldwide and 9.0 percent of DALYs. The report also addresses these substances individually, and their differential impact according to global region and country characteristics. For instance, among the 24 risks considered, alcohol use is the third leading contributor to the global burden of disease, whereas tobacco use ranks sixth and illicit drug use ranks eighteenth. Alcohol places the largest toll on men in Africa, in middle income

countries in the Americas, and in some high income countries. Tobacco use differentially affects countries according to income level, as it is the leading cause of DALYs in high income countries and the third cause in middle income countries, but does not rank in the top ten for low-income countries (World Health Organization, 2009). Evidence indicates that substance misuse is increasing most quickly in regions that are experiencing dramatic societal change, as is common in developing countries (World Health Organization, 2007). These statistics are especially troubling in that they are linked to pain and suffering experienced not only by the person engaging in substance misuse, but also by their families and friends. In addition, even persons who are not directly connected to the individual engaged in substance misuse can, nonetheless, be directly affected through criminal activity, motor vehicle accidents, and violence. Thus, the negative effects of substance misuse extend well beyond the person engaged in the problematic behavior.

In addition to these health-focused outcomes, substance misuse entails great financial cost for societies, including both direct and indirect costs associated with hospitalization, treatment, accidents, law enforcement, criminal activity, and lower human productivity. For example, in the United States the cost of smoking was estimated to be \$138 billion per year in 1995 (National Institutes of Health, 2000), the annual cost of alcohol abuse and dependency was estimated to be \$184.6 billion in 1998 (Harwood, 2000), and the yearly cost of illicit drug use was estimated to be \$180.8 billion in 2002 (Office of National Drug Control Policy, 2004). Costs related to substance misuse are similarly large in other parts of the world. A review of health care costs by twelve European Union countries in the 1990s indicated a total expenditure of approximately 1.7 billion Euros connected to drug use, with the per person expenditure being double the amount observed in the United States (Kopp & Fenoglio, 2003). Overall, regardless of whether the total cost of substance misuse is measured in terms of human suffering, disease burden, or monetary expenditures, substance misuse severely impacts individuals, societies, and economies around the world.

The negative outcomes associated with substance misuse naturally encourage efforts to reduce its prevalence, including the strategies of both treatment and prevention. Treatment of substance misuse is hypothetically attractive, because resources are directed specifically at those who require help. There exist a number of behavioral and pharmacological treatments effective at reducing the rate or severity of substance misuse (National Institute on Drug Abuse, 2009). However, it is often the case that persons who could benefit from treatment are not identified, or they are not willing to participate in treatment. As a result, taking a treatment approach alone allows the possibility that many of the negative outcomes associated with substance misuse could occur before intervention can address the problematic behavior. Further, successful treatment can be challenging because substance use disorders emerge out of developmental processes (Kellam, Koretz & Mo cicki, 1999). That is, over time youth continuously interact and transact with multiple entities (e.g., family, peers, school) in their social environment, and thereby establish an array of beliefs, attitudes, behavioral patterns, relationships and competencies that could be difficult for treatment to modify. In addition, outcomes experienced at younger ages cumulatively shape the youth's risk-related outcomes at later points in time, and thus operate to maintain a particular trajectory in what might be termed a “developmental cascade” of risk, that becomes increasingly difficult for treatment to divert (Dodge, Malone, Lansford, Miller, Pettit & Bates, 2009; Masten et al., 2005). Moreover, a person who exhibits substance misuse may be physiologically addicted, thereby requiring a treatment outcome of complete abstinence before significant improvement can be realized. Among others, these limitations of treatment approaches for the reduction of the substance misuse prevalence suggest consideration of supplementing such approaches with those entailing preventive interventions.

Successful prevention programming: Importance of being evidence-based and developmentally well-timed

The great costs of substance misuse combined with the limitations of attempting to reduce its prevalence primarily through treatment of individuals already exhibiting the problem behavior encourage consideration of prevention efforts as a means of reducing these costs. There are numerous interventions designed to prevent substance misuse, and differences exist among them with regard to effectiveness and cost to implement. Comprehensive reviews and intervention outcome comparisons are available (e.g., Aos, Lieb, Mayfield, Miller, & Pennucci, 2004; Miller & Hendrie, 2005; Spoth, Greenberg & Turrissi, 2008; Tobler, Roona, Ochshorn, Marshall, Streke & Stackpole, 2000). Such reviews, however, cannot consider interventions that have not yet been tested, and results for those that have been tested may not generalize to different cultures and settings. For this reason, it is useful to detail broad characteristics that will typify those intervention strategies that are most promising for large-scale implementation and achieving a favorable public health impact, thereby providing initial guidance in program selection in the absence of an empirical record.

Evidence-based

Preventive interventions are labeled evidence-based to the degree that they are theoretically grounded and empirically supported (Flay et al., 2005). A theoretical foundation is helpful for developing and systematically testing and modifying intervention components (Hawkins, Catalano, & Miller, 1992). An intervention may be grounded not only on “big theory”, which specifies the factors and processes that affect substance misuse in general, but also on “small theory” which proposes how a specific intervention operates to prevent substance misuse (Kellam et al., 1999; Spoth, Redmond & Shin, 1998; Lipsey, 1990). The ability to propose and test specific relationships enables intervention improvement, as the results indicate what modifications may be necessary. Thus, theoretical grounding encourages empirical testing, with those strategies and interventions that receive empirical support being those that are most likely to be truly effective and, therefore, most worthy of consideration for further implementation. The importance of being evidence-based is reflected by the degree to which it permeates the Preventive Intervention Research Cycle (PIRC), a model developed by the Institute of Medicine to guide the design, development, and testing of preventive interventions to increase the likelihood that they will improve public health (Institute of Medicine, 1994; National Research Council and Institute of Medicine, 2009). Notably, the PIRC indicates the necessity of program sustainability in the context of “the real world”, and specifically highlights the essential role of economic analysis at every phase of intervention development.

Developmental timing

Early, well-timed, and developmentally appropriate preventive interventions among youth can capitalize on the fact that attempts to modify risk factors are most successful when the precursors of risk are nascent – before they evolve and reify into established attitudes and behaviors that may be more difficult to change (e.g., Hawkins et al., 1992). The developmental perspective of prevention views substance misuse as behaviors that emerge out of a trajectory of risk that begins long before the behavior occurs (Dodge et al., 2009). Therefore, prevention efforts that favorably impact critical risk factors at opportune points in time can alter the risk trajectory for youth. Over time the beneficial effect increases as maturing youth develop along more favorable trajectories, ultimately leading to increasingly positive adult outcomes (Spoth, Trudeau, Guyll, Shin, & Redmond, 2009). Consistent with this idea, successful efforts to prevent risk factors for future substance misuse can begin in

children less than five years of age, well before substance misuse typically begins (Webster-Stratton, 1998).

The particular case of substance misuse prevention illustrates how preventive interventions are likely to be most effective when they are delivered at critical points in development, when youth are old enough to benefit from prevention programming, but prior to the age at which initiation of the problematic behavior becomes common. With regard to substance misuse, perhaps the most important period for intervention occurs at the threshold of adolescence (Dodge et al., 2009; Spoth et al., 2009; Windle et al., 2008). A variety of newly emerging factors make this a critical time for youth, including experiencing a shift in the relative importance of socialization from the family to peers and friends, greater autonomy, a desire to demonstrate independence and react against perceptions of parental control, and an increased exposure to substance use opportunities and offers (Masten et al., 2008).

Economic potential of universal prevention

Breadth of impact and cost of targeted behavior

Effective interventions are an obvious and essential component of a successful public health prevention campaign, but they are not themselves sufficient to ensure an economic return. In particular, the problem behavior to be prevented by intervention will determine the maximum potential savings of universal prevention. Similar to population-level vaccination programs that seek to reduce the prevalence of a biological disease, universal substance misuse preventive interventions are designed to be appropriate for nearly all youth in a population, seeking to include them in prevention efforts regardless of their individual risk or substance misuse behaviors. Such widespread efforts become increasingly appropriate and economically attractive to the degree that the prevalence of a problem behavior is high (Offord, Kraemer, Kazdin, Jensen & Harrington, 1998). For instance, if an intervention is successful at preventing 50% of future cases of misuse for a particular substance, the absolute number of cases of misuse prevented will be larger (and the cost savings greater) if the misuse occurs in 20% of the population than if it occurs in only 2% of the population. Also important is the degree of cost associated with each case. Just as various substances will differ with respect to the severity of the impact their misuse has on functioning, they will also differ with respect to the costs their misuse imposes on individuals, families, governments and societies. Thus, interventions have a greater potential impact when they target types of substance misuse that have higher prevalence in the populations or that are associated with higher economic costs.

Scaling up, dissemination, and sustainability

In order to actually achieve a broad impact and demonstrate positive effects on public health, it is necessary for universal interventions to “scale up” and be implemented in a significant portion of the target population. Scaling up requires consideration of factors beyond those associated with intervention effectiveness, such as mustering the administrative, human, and financial resources required to commence a large scale effort (Arthur & Blitz, 2000; Spoth, 2007; Spoth & Greenberg, in press). The intervention must be effectively disseminated, requiring buy-in from societal institutions and stakeholders, such as local governments, schools, religious groups, employers, and clinics, as well as participating families and individuals. Thus, the intervention must provide a good contextual fit with both the implementation sites and the population, being consistent with their needs and values (Albin, Lucyshyn, Horner & Flannery, 1996). Finally, the preventive intervention must be continuously sustained over the long term. Sustainability corresponds to not only ensuring that the intervention is being regularly implemented in the population over time, but also that the implementation continues to be of high quality, maintaining fidelity to the

intervention theory, and continuing to produce the positive effects for which it was initiated (McIntosh, Horner & Sugai, 2009; Spoth & Greenberg, in press). Sustainability is an ongoing process that entails continuing efforts, assessments, evaluation and modification. Sustainability is facilitated by policy and administrative supports that both ensure a prevention effort remains a priority and provide the resources required for continuous technical assistance, training, implementation quality assessments, and outcome assessments to maximize the likelihood of continued effectiveness (McIntosh, Filter, Bennett, Ryan & Sugai, 2010). Sustainability planning is critical to make certain that society continues to reap the anticipated benefits of prevention programming beyond the initial start up period.

Economic challenges facing universal prevention

The existence of effective preventive interventions is not sufficient for sustained, universal prevention. Such an undertaking also requires favorable action on the part of policy makers because any large-scale effort involves the dedication of substantial resources. At any given time there exist a number of effective interventions, and the total costs for supporting all of them would outstrip the finite resources that are available. There is a need, therefore, to be able to evaluate and choose among a variety of potential interventions. This choice might be focused on choosing among programs that address a problem identified as a priority for prevention. For example, if the prevention of alcohol misuse is identified as a priority, the relevant programs may be compared on both how much they cost to implement and how much they tend to decrease rates of misuse. However, the choice may be more complex, in which programs that address different outcomes need to be compared, or in which a preventive intervention must be compared with initiatives largely unrelated to health, such as investments in education, job training, or construction. Though these various ventures seek to achieve categorically different outcomes, they nonetheless compete for the same resources, and the decision regarding which to support requires a fair comparison on a common metric. Economic analysis provides a systematic means for making such comparisons, thereby enabling more informed decisions.

Types of economic analysis

There are several forms of economic analysis that can be useful for the evaluation of preventive intervention programs. All types of analysis entail the calculation of program costs, but thereafter differ in regard to the specific outcome by which the program effects are assessed. The following sections provide descriptive overviews of several major categories of economic analysis, and include broad discussion of some pertinent issues. The presentation is necessarily general, and does not attempt to exhaustively consider the manifold details that attend all economic analyses. A number of excellent sources exist in which the interested reader may find technically detailed presentations of economic analyses (e.g., Drummond & McGuire, 2001; Gold, Siegel, Russell & Weinstein, 1996).

Analytic perspective

One issue that affects all economic analyses and therefore merits discussion is the perspective of the analysis, which defines the types of costs and benefits that will be considered. Perhaps most commonly encouraged are analyses that take a societal perspective (e.g., Kaplan & Groessl, 2002), ones which seek to account for and monetize all resources expended and all benefits realized, regardless of who or which entity actually bears the cost or enjoys the economic return. For example, a societal perspective analysis of a school-based intervention that required school districts to purchase workbooks, but relied on volunteers to deliver the intervention, would require monetizing both supplies and volunteers' "salaries" (i.e., the market value of their donated time) in assessing program costs (Foster, Dodge & Jones, 2003). However, it can also be of practical importance to

perform an analysis from the perspective of a particular stakeholder, such as government, taxpayers, or employers (e.g., Aos et al., 2004; Guyll, Spoth & Crowley, in press). In the hypothetical situation described above, from the perspective of the school district, the use of volunteers as opposed to hiring personnel would represent real cost savings. Although a non-societal perspective may yield less comprehensive estimates, they can be useful for budgetary planning and demonstrating the potential good to influential stakeholders, thereby gaining the support necessary for passing new policy initiatives. In any case, a fair comparison of alternative preventive interventions, or of a prevention effort with any other use of the same money, requires that their economic analyses be conducted from the same perspective.

Cost analysis

As the most basic form of economic evaluation, cost analysis entails an assessment of program costs. In short, cost analysis quantifies the resources required to implement the program. Some of these costs will be readily available to evaluators, inasmuch as they are likely to be direct and explicit, including training costs, salaries, supplies, and participation incentives. Less apparent and more challenging to quantify will be overhead costs, and costs borne by others, such as volunteer labor, donations of facilities used, participant transportation costs, and participant time. As noted by Drummond, Stoddart and Torrance (1987), if the cost analysis is for the purpose of comparing interventions that utilize similar quantities of a resource – such as two prevention programs that both consume 25 hours use of a donated facility – these costs need not be estimated as they will offset each other. However, this limits the analysis because results cannot be immediately compared to other programs with dissimilar sources of costs, and the total cost will be underestimated. In addition, given the importance of monitoring implementation quality and program effectiveness for the purpose of sustainability, as well as continuously evaluating and revising the program, the associated assessment costs should be considered in budgeting for long-term and widespread dissemination efforts (Pentz, 1998). Ultimately, cost analyses can yield several bases for program evaluation. These include not only total costs for implementation, but also the average cost, calculated as the total cost divided by the number of individuals receiving the intervention. For purposes of universal prevention, school-based programs can be especially attractive because they maximize attendance and can reduce per child costs, averaging approximately \$220 per child in the United States (Miller & Hendrie, 2009). Particularly germane for comparing programs intended for continuous implementation is the marginal cost, which is the incremental cost incurred by intervening with one additional participant (Drummond et al., 1987). Marginal costs tend to decrease as intervention efforts are scaled up, interventions are continuously implemented in a sustained fashion, and costs associated with intervention start up have ended. However, it might be desirable to include start-up costs, as when evaluating the possibility of beginning implementation of a new program. In such cases it is advised to assess costs across a time horizon, such as 10 years, over which the intervention will have been actively implemented, and after which start up costs would have been incurred. The start up costs can then be accounted for by annualizing them across the time horizon of the analysis (Baltussen et al., 2003). As previously noted, cost analysis is required for each of the other varieties of economic evaluations of interventions, inasmuch as each entails calculating the intervention cost associated with achieving a particular outcome.

Cost-effectiveness

Though programs may be compared on cost alone, it makes little sense to consider programs that do not achieve the ends for which they were designed. Any funds spent on even the least expensive prevention program would be wasted if the program did not successfully reduce the occurrence of the targeted condition among the treated population. Accordingly,

in the PIRC model for development of preventive interventions, empirical study focuses in large part on tests of efficacy and effectiveness. In particular, efficacy corresponds to how well an intervention performs under ideal conditions, such as those characteristically associated with clinical trials. By contrast, intervention effectiveness refers to how well an intervention prevents an outcome under real-world conditions (Flay et al., 2005). Efficacy studies predominate in initial tests of an intervention. By contrast, effectiveness studies are typically conducted after efficacy is shown, when an intervention has developed to the point that it is manualized and ready for implementation by third parties, and when the focus is establishing the generalizability of an intervention's effect on a practical outcome. Cost-effectiveness analyses quantify the ratio of the intervention cost to intervention outcomes, thus estimating the cost required to produce each unit of prevention. For example, cost-effectiveness analyses based on effectiveness studies suggest that effective family-focused prevention programs require between \$12,000 and \$20,000 to prevent a single alcohol use disorder (Spath, Guyll & Day, 2002), and that effective school-based drug prevention programs cost approximately \$39 to prevent the consumption of each gram of cocaine (Caulkins, Rydell, Everingham, Chiesa & Bushway, 1999). Cost effectiveness may be used to compare alternative courses of action, such as implementation of a substance use prevention program versus doing nothing, or implementation of one prevention program versus another. Cost-effectiveness can provide comparisons between alternatives when the same outcome is assessed for both alternatives. For example, two substance use prevention programs can be compared on the cost to prevent initiation of alcohol use if both assess that outcome. However, the programs cannot be compared if their effectiveness is measured according to different outcomes, such as the number of alcohol disorders as opposed to grams of cocaine consumed.

Cost utility

In terms of economic analysis, utility has been conceptualized as a general good, relating to factors such as happiness, satisfaction, or goal achievement (e.g., Baron, 1996). In terms of preventing substance misuse, increases in utility result from an intervention producing “goodness” by enabling people to achieve the greater satisfaction and happiness that comes with averting substance misuse and leading happier, healthier lives. As such, utility corresponds to an intervention effect, and cost-utility analyses are understood as being a specific type of cost effectiveness analysis (Gold et al., 1996).

In health economics, utility is commonly assessed in terms of Quality Adjusted Life Years (QALYs), a metric that combines both length and quality of life (Drummond, 1987). Conceptually, a particular health state is quantified on a scale ranging from 0 to 1, with these extreme values corresponding to death and perfect health, respectively, and this weight is multiplied by the number of years one lives in that state of health. As reviewed by Drummond et al. (1987), several methods exist for estimating the weights of intermediate health states, including rating on an analogue scale, ascertaining how many years of perfectly healthy life one would be willing to trade away to avoid a suboptimal health state, and how much risk of death one would be willing to accept in order to move from a suboptimal health state to perfect health.

On average, effective interventions will allow individuals to enjoy healthier and longer lives and, hence, more QALYs than would have otherwise been the case. The cost of an intervention can be divided by the resulting increase in QALYs to yield the cost required to produce one year of perfect health. For example, Rasch and Greiner's (2008) review of economic analyses of various adolescent smoking prevention strategies indicated that in most cases primary prevention cost less than 20,000 Euros per QALY gained, albeit with wide variations among the investigated programs. By focusing on the production of QALYs, cost-utility analysis enables comparisons among programs designed to prevent, treat, or

ameliorate any kind of health problem, and is not limited to only comparing interventions addressing the same problematic behavior. A further characteristic of cost-utility analysis often held to be advantageous is that it focuses on the cost to produce an increase in the length and quality of an individual's life, and not their economic productivity, thereby uncoupling the valuation of health from its market value. This same characteristic may also be viewed as a drawback, inasmuch as it does not directly reflect the full societal benefit associated with the program outcome, though the QALY can, itself, be monetized (Drummond & McGuire, 2001).

Cost-benefit analysis

Cost-benefit analysis provides a means of comparing interventions without the constraint that their effectiveness be assessed in identical units. Indeed, cost-benefit analysis enables comparison between a prevention program and any other conceivable use of the same money. As with all economic analyses, the first step entails quantifying the monetary resources consumed by an intervention through cost-analysis. However, the generality of the application of cost-benefit analysis is achieved by transforming all program outcomes and effects into financial units as well. That is, the outcome of a substance use prevention program is not ultimately quantified in terms of how much substance misuse it has prevented, but rather in terms of the monetary costs-avoided and benefits-gained as a result of the program. The results of cost-benefit analyses may be quantified in terms of the benefit-cost ratio – the amount of money returned in benefits for each unit of money spent on prevention. For example, in performing a cost-benefit analysis of alcohol prevention for the Iowa Strengthening Families Program (ISFP) delivered to adolescents and their families, Spoth et al. (2002) first assessed the age of onset of adolescent alcohol use initiation, and then used this directly observed outcome to estimate that ISFP would prevent an average of 5.5 future alcohol use disorders per 100 adolescents targeted for prevention, relative to a no-treatment control condition. Subsequently, the authors estimated the life-long monetary benefit to society associated with preventing one alcohol use disorder to be nearly \$120,000, which ultimately indicated that ISFP produced \$662,000 in savings per 100 adolescents. The benefit-cost ratio was then calculated by dividing this dollar benefit by the cost to deliver ISFP to 100 adolescents and their families, determined by the cost-analysis to average nearly \$69,000, yielding a result of \$9.60 in benefit returned for each \$1 of intervention cost. Additionally, cost-benefit analysis provides an estimate of an intervention's net-benefit, which corresponds to the average amount of benefit returned for each participant, less the cost to treat each participant. For example, Spoth et al. (2002) report the ISFP produced a net benefit of \$5,923 for each adolescent.

Although valuation of preventive intervention outcomes is conceptually straightforward, it presents difficult challenges in practice. First, the beneficial effects that result from successful prevention of substance misuse are experienced over the participants' ensuing lifetimes. Thus, the positive effects of an adolescent preventive intervention may extend more than 50 years after intervention delivery, and would not be directly observed. Therefore, some strategy must be developed to project and estimate the long-term outcomes from more proximal intervention outcomes, as indicated in the example of Spoth et al. (2002) described above. Second, the monetary value of these life-long effects must be determined. For example, although prevention of substance misuse may be expected to increase rates of employment and employee productivity, one must estimate the present values of the anticipated earnings across an entire lifetime (e.g., Caulkins, Pacula, Paddock & Chiesa, 2002). Again, these effects and their economic values are not directly observed, but instead must be estimated on the basis of simplifying assumptions, gross generalizations, and reliance upon a combination of archival data and reasoned analysis. A third challenge to attaching a monetary value to preventive intervention benefits is that there exist different

theoretical perspectives regarding how outcomes ought to be monetized (Hodgson & Meiners, 1982). For example, the human capital approach assigns monetary values according to how the outcomes relate to human productivity. Specifically, preventing an individual from engaging in substance misuse will increase that person's future economic productivity, and will also avoid the loss of other individuals' future economic productivity that would have been lost as a result of the misuse, such as through accidents, health care, crime, and incarceration. Thus, the human capital approach is tied to economic worth and, hence, the marketplace. It only values outcomes that have an economic value, and does not consider benefits such as averting pain and suffering by preventing substance misuse. Alternatively, economic analyses may attempt to value program effects through the willingness to pay approach, in which monetary value is based on how much society would be willing to pay in order to achieve a particular outcome, such as preventing one individual from engaging in substance misuse. Obviously results of a cost-benefit analysis can be greatly affected by the approach chosen for valuing outcomes.

In addition to these challenges, results of cost-benefit analysis can provide incomplete information in some cases. For example, one can imagine an analysis conducted from a societal perspective in which all costs and benefits for all persons are considered, but the costs of implementation are borne by one entity – such as government or taxpayers – whereas the benefits are primarily enjoyed by a different entity – such as individuals. Thus, the overall benefit-cost ratio could be quite favorable, but from the perspective of the funding entity it may be unaffordable (Miller & Hendrie, 2009). It is also possible that a favorable benefit-cost ratio could be associated with a very costly program that is anticipated to return benefits slowly across a long period of time in the future, but that requires large lump-sum investments in the present. The funding source may simply not be able to produce the capital investment necessary to begin the program with its resources in the present. An analogous situation would be the issuing of a bond that offers a favorable cumulative long-term return, but the initial purchase of the bond itself exceeds an individual's total financial worth. Despite these challenges and limitations associated with transforming all program inputs and outcomes into monetary units, cost-benefit analysis is a powerful tool that can provide a direct comparison between prevention programming and any other use of the same money.

Challenges to enhancing the international relevance of economic analyses

As indicated by the foregoing descriptions, economic analyses provide new evaluative dimensions for assessing prevention programs beyond simple efficacy and effectiveness assessments. Not only may they be used to compare programs that target the same outcome, but they can be broadened to enable comparisons of a particular program with any other health-relevant effort or, indeed, with any other conceivable use of the same money. As noted above, a large number of assumptions and decisions must be made in the conduct of any economic analysis. These choices might cause the results to be highly relevant to a particular nation, but simultaneously decrease their usefulness for other countries. In the following sections we discuss some of the factors that can limit the international generalizability of economic analyses.

Effectiveness

As noted above, intervention effectiveness is a precondition for favorable economic performance. It makes sense to evaluate interventions that are actually effective at preventing substance misuse, because they are the only ones that could possibly deliver a favorable return for the money invested. But preventive interventions are typically conceived, developed and tested within a single society, or at best in several nations that are highly similar in comparison to the full range of global variation. Whether one considers

general theories of substance use, or specific theories relating to how particular interventions produce their effects, the large majority of published work has been conducted in highly developed countries. Interventions shown to be effective in a particular cultural context may be somewhat ill-conceived for use in a dissimilar culture, especially where the infrastructure for intervention implementation is limited. As a result, an intervention's effectiveness may be less in another country, which would directly decrease its economic potential. These concerns bear on general issues relating to external validity and the generalizability of effects. Though it is not feasible to demonstrate intervention effectiveness in every possible population, there is a need to demonstrate robust effects across cultural contexts or, at a minimum, to explicitly consider the issue in conjunction with knowledgeable informants from a population in which the intervention is to be implemented (Tsarouk, Thompson, Herting, Walsh & Randell, 2007). Alternatively, program development may be facilitated by blending established principles with culturally adapted implementation. Chen, Fang, Li, Stanton and Lin (2006) describe this process in creating the school-based Stay Away from Tobacco program in China. For example, the program includes an established component of improving youths' skills in identifying deceptive and manipulative pro-tobacco messages, but adapted the presentation for implementation in China, where public advertisement has been banned, and tobacco companies use other means to promote smoking.

Dissemination infrastructure

The challenges of taking an intervention from relatively small effectiveness trials to large scale implementation on a national level are well recognized (Kellam et al, 1999; Spoth & Greenberg, 2005). The ability to disseminate a program to an entire population will be affected by the existing infrastructure, including physical assets such as roadways and telecommunication networks. Perhaps even more critical are the availability of social and human capital. For example, a public school system provides an organized network capable of reaching a large proportion of children and adolescents, and further possesses a large amount of human resources in the form of teachers and administrators. A particular country will be less prepared to disseminate a preventive intervention to the degree that it lacks such resources. As a consequence, evaluations of interventions disseminated in highly developed countries will represent a lower bound of costs required to deliver the program to a population, and their universal implementation in a less developed country may be less economically advantageous.

Intervention costs

After establishing effectiveness, the fundamental input to an economic analysis is the cost of the intervention. Though it presents its own challenges, cost assessment is typically the most straightforward task in economic analysis. Program evaluators should have solid data regarding the human and capital resources consumed during program implementation, and can draw upon other data sources to attach a monetary value to those resources. For example, the donated use of a room in a community center can be monetized by the cost to rent a similar space in the area, and the economic value of participants' time can be variously estimated from wage rates. Though these decisions may require addressing difficult issues, the process can be thoroughly explicated and defended within a particular context. However, making the results comparable across societies introduces complexities. First, the existence of different currencies requires translation of costs through exchange rates, or into a common unit, such as international dollars (United Nations, 1992). More difficult, however, is that one unit of the same resource can have different costs in different locations. The cost of one pencil may be different, as may the costs of one mile traveled, or one hour of participant time, and so forth. Accurate cost assessment across contexts requires consideration of these differences.

Outcome estimation

The outcome that will need to be estimated depends on the kind of economic analysis to be conducted. For example, cost-effectiveness may entail estimation of substance use disorders prevented, whereas cost-utility may assess QALYs produced, and cost-benefit may estimate dollars saved. Implicit in each of these estimations is the consideration of at least two conditions; one in which the intervention is implemented, and one that serves as a comparison condition. For prevention of substance misuse, the comparison condition is oftentimes taken as the situation for which no intervention at all is delivered. Thus, the outcome associated with intervention delivery will be in comparison to a counterfactual condition of what the outcome would have been without the intervention. However, the expected outcome in the absence of intervention may differ across national boundaries. Prevalence of alcohol misuse in European nations will be greater than in Middle Eastern nations where cultural and religious norms often combine with legal prohibition to keep disorder rates very low (Rajendram, Lewinson & Preedy, 2006). Operating similar to a floor effect, very low prevalence rates in the absence of intervention will make cost-effectiveness estimates much less favorable, as each unit of implementation cost can produce very few additional units of prevention.

The estimation of intervention-benefits can be especially challenging in prevention of substance misuse. Although there may be some outcomes that could be realized relatively soon after intervention delivery that can be directly observed (e.g., less juvenile delinquency, better school performance), preventing substance misuse can have a continuing and lifelong impact on an individual, and could affect their functioning in multiple domains (Harwood, 2000). Thus, a comprehensive accounting of all prevention benefits requires estimation of life trajectories with regard to a number of factors, including employment, health, and criminality, ultimately enabling the full monetization of an individual's outcomes with respect to those factors. If an analysis is conducted using the human capital approach, one confronts the question of whether the prevention of a substance misuse in one individual in a highly developed society is worth more than prevention of the same substance misuse behavior in another individual in a developing society that affords less opportunity for individuals to be economically productive (Landefeld & Seskin, 1982; Rosenzweig, 2000). Furthermore, other approaches to monetizing outcomes, such as willingness to pay, may not adequately address the issue if one society enjoys more disposable income than another, which could inflate the value of prevention for individuals in wealthier economies.

The results generated by performing cost-utility analysis also can vary according to the setting in which prevention is conducted. As noted above, the utility produced by prevention of substance misuse is the increased utility associated with the healthier life enjoyed as a result of prevention. Utility outcomes associated with particular conditions are typically based on subjective evaluations, such as how many years of life lived with substance misuse one would be willing to give up in exchange for living fewer years in perfect health. It is conceivable that a given condition would be perceived to impact quality of life more in one nation or society than in another (Dix-Smith, Drummond, & Brixner, 2009). Likewise, people's conceptualization of the hypothetical counterfactuals presented in procedures used to determine utilities, such as a life lived in perfect health, might not be associated with the same degree of satisfaction for people in different cultures. Though results generated will be on a common metric, it is still the case that other factors could bias the true value of the underlying construct.

Solutions and ways forward

The foregoing challenges associated with making results of economic analyses internationally useful may be collectively described as related to contextualization.

Specifically, the associated costs, effectiveness, outcomes, and societal conditions in an analysis typically are specific to a particular context. The large majority of economic evaluations tend to be conducted in societies with well-developed and industrialized economies, thereby limiting their usefulness for setting health policy priorities in less developed regions that experience poor health outcomes (Murray, Evans, Acharya & Baltussen, 2000). In recognition of the need to broaden the informative value provided by economic evaluation, the United Nations World Health Organization (WHO) has led efforts to address a number of the associated challenges. One facet of these efforts entails acquiring detailed information for a large number of specific conditions in various geo-political regions. For example, the *Global Burden of Disease and Injury Series* (Murray & Lopez, 1996) and the *Comparative Risk Assessment* project (World Health Organization, 2009) provide assessments of current and projected levels of health outcomes in specific regions, estimating the contributions of particular risk factors, such as smoking, alcohol, and illicit drug use. Coupled with these tasks of providing context-specific information are the endeavors to develop general outcome measures and analytic frameworks that can facilitate policy discussions and transcend national and regional contexts, as subsequently discussed.

A common metric: The Disability Adjusted Life Year (DALY)

The World Health Organization has promoted the development of the DALY as a common unit for quantifying the death and disability associated with unfavorable health conditions, diseases and disorders (Murray & Lopez, 1996). A single DALY corresponds to the complete loss of one year of healthy, non-disabled life. A DALY could, therefore, alternatively reflect the death of a healthy individual that is one year premature, or an individual living with a 50% disability for two years, or an individual living with a 25% disability for two years followed by a death that is six months premature. Thus, as with the QALY, the DALY trades off the length of life with the quality (i.e., lack of disability) of those years of life. By way of specific examples, an individual would need to live with blindness (disability weight = .600; World Health Organization, 2004) for 1.7 years, or with an alcohol use disorder (disability weight = .134) for 7.5 years, to yield the same disease burden associated with the death of a healthy individual that is premature by 1 year.

The DALY reflects an attempt to quantify the total amount of negative health caused by a condition, combining fatal and nonfatal outcomes by including both the amount of premature death and the length and severity of disability. This quantification enables all conditions to be directly compared on the basis of their associated DALYs, and facilitates assessments of health care needs. In particular, epidemiologic data can be transformed into DALYs to estimate the *disease burden* experienced by a country or region for a specific condition or, indeed, for all conditions together (e.g., Murray & Lopez, 1996). Furthermore, because the DALY is a general outcome, all preventive, curative, or palliative interventions for all conditions may be directly compared with each other on the basis of their abilities to decrease DALYs.

A common metric should enable fair comparisons of health care needs and intervention effects for any and all diseases and conditions. Accordingly, the DALY was crafted to capture common and universally valued elements of utility, inasmuch as the extension of life and removal of disability are nearly universally held as goods. Moreover, DALYs are calculated relative to a standard population (albeit separately by gender) to avoid the possibility that prevention or treatment of the same condition might result in averting more DALYs for people in high life expectancy countries, but fewer for people in low life expectancy countries (Murray & Lopez, 1996).

Certainly the DALY is not a perfect metric for all uses, and its implementation has been criticized on grounds that it is ethically flawed, or does not appropriately prioritize health

needs (e.g., Anand & Hanson, 1997; Kothari & Gulati, 1997). Controversial aspects of DALY calculation include age-weighting wherein years of life in young adulthood are more highly valued than those at other ages, and discounting, such that future years of life (and, hence, the lives of future generations) are less valued than are proximal years of life (and lives in the current generation). The DALY is further limited in that it does not attempt to quantify how one DALY of an affected individual might reduce the quality of life for that person's family or friends. Nor does it directly relate to economic outcomes, such as lost productivity. However, the DALY was not developed with the intention that it would address all possible issues. Rather, it largely succeeds in the purpose for which it was designed – to provide a basic and universally applicable outcome for evaluation and discussion of health-related needs, interventions, and policies.

A common analytic approach: Generalized cost-effectiveness

As typically conducted, cost-effectiveness analysis evaluates an intervention as if it were implemented in isolation from other interventions, programs, or policies that seek to achieve the same outcome. Results for a particular intervention might be compared to those for another intervention, or to those for the alternative condition of no intervention at all. The implicit assumption is that the most cost effective intervention may be identified, suggesting the advisability of channeling funding to that intervention in order to have the greatest health improvement for the least cost. However, this approach ignores the reality that many conditions can be addressed in multiple ways. For example, rates of cigarette smoking may be reduced by school-based prevention programs, prohibiting sales to minors, exposing a population to anti-smoking messages, or increasing taxes on tobacco products (Rasch & Greiner, 2008). Additionally, cost-effectiveness analyses as typically conducted provide comparatively simplistic information for the complex reality in which health policy decisions must be made. For example, there is usually a pre-existing and complex mix of programs to address major health conditions, funding for some of which may be mandated by law, and total funding being constrained by budgets (Murray, Evans, Acharya & Baltussen, 2000). Analyses that attempt to address all of these highly contextualized factors – such as by employing resource allocation modeling (e.g., Stinnett & Paltiel, 1996) – may succeed in producing a result that is useful to a particular policy maker at a particular point in time, but would be of little use for decision making in dissimilar contexts presented by different countries, financial realities, political pressures, or different times.

Generalized cost effectiveness analysis is designed to estimate the most advantageous mix of interventions that will, in the aggregate, yield the greatest health effect for the least amount of money (Murray et al., 2000). The analysis combines the costs and effectiveness of multiple programs, thereby estimating their complementary effects to suggest the optimal mix of strategies and propose the most efficient relative distribution of funding among the strategies. To provide a universally meaningful comparison condition, generalized cost-effectiveness compares the most advantageous mix to the natural history of the disease in the absence of any intervention. Because it would limit the generalizability of the results, generalized cost-effectiveness does not attempt to account for contextualized factors such as the political considerations or health care infrastructures existing in a particular nation. Instead, the available budget constitutes the only constraint considered (Murray et al., 2000). As with the DALY, the purpose of generalized cost-effectiveness analysis is not to provide the most pertinent and detailed information to every possible decision maker. Rather, it offers general information that is relevant to all, and offers a unifying framework to promote constructive discussions across contexts regarding the allocation of health resources. However, to make these general analyses useful to individual societies, the WHO-CHOICE (CHOosing Interventions that are Cost-Effective) project provides results pertaining to the most advantageous mix of interventions across 14 epidemiologic sub-regions of the world.

WHO-CHOICE further enables policy makers to tailor these generalized cost-effectiveness analyses to a particular nation's resources, capacities, and constraints, thereby adjusting intervention effectiveness and intervention costs and ultimately producing a country-specific cost-effectiveness analysis that is more useful to local policy makers (Hutubessy, Chisholm & Edejer, 2003). The generalized approach has also been used to broadly evaluate strategies for reducing the global burden associated with substance misuse (Chisholm, Doran, Shibuya & Rehm, 2006), though most of the strategies considered pertained to treatment and harm reduction, and not specifically to prevention.

Conclusion

With regard to prevention generally, and substance misuse prevention in particular, economic analysis provides a powerful tool for assessing health care needs, evaluating effectiveness, comparing interventions, as well as comparing prevention with treatment to determine whether, in fact, an ounce of prevention is worth a pound of cure. Health care policy choices must be made under conditions that are not only exceedingly complex, but also unique to each nation. Traditional, highly contextualized analytic approaches can be well-suited for informing such decisions by providing individual policy makers with relevant and specific information from a desired analytic perspective, whether governmental, societal, or individual. The particular economic analysis, whether cost analysis, cost-effectiveness, cost-utility, or cost-benefit, can be chosen to examine the outcome of greatest interest, whether quantification of costs, reduction of prevalence, maximizing quality of life, minimizing disease burden, or maximizing human economic productivity and financial return. However, due to myriad dissimilarities, such specific analyses may be of limited usefulness for informing decisions in other contexts, or for guiding discussions across national boundaries. Recent developments in assessments and analysis, as reflected in the use of DALYs and generalized cost-effectiveness, have begun to address these challenges, with the acknowledgement that the greater generality might require additional specific and contextualized approaches to provide the most useful information to any particular policy maker. Thus, the specific and general approaches are not truly in competition, but rather offer complementary economic evaluations that together can enrich the information for making health care decisions in different international contexts.

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Marilyn Cornish received her M.S. in Psychology from Iowa State University and is currently a Doctoral student in Counseling Psychology at Iowa State University. Her research interests include the processes and outcomes of counseling and other interventions, diversity factors in counseling, and stigma associated with help-seeking behaviors.

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