Prevention Research and Its Actual Application to Health Services

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Abstract

The effectiveness of alcohol abuse programs, whether to treat or to prevent, is of major importance to health services research. Demonstrating effectiveness has been appropriate to establish a sound scientific basis for these programs and to increase public acceptance. Analysis of the costs of prevention efforts in terms of their demonstrated effectiveness in reducing health services demand also is essential. In the end, health services policy deliberations are optimally based on what effect is delivered for the cost of the service, not simply on a determination of which service is the most effective. However, in a time of scarce resources prevention should be studied with the same rigor as treatment in order to determine the best return on investment.

Introduction

The effectiveness of alcohol abuse programs, whether to treat dependent individuals or to prevent future problems, is of major importance to health services research. Demonstrating effectiveness has been appropriate to establish a sound scientific basis for treatment and prevention programs, and to increase public acceptance. Research has given good cause for optimism among people who provide and who fund treatment and prevention (ie, optimism that programs can have the desired effects).

Health services research examines services that are intended to affect current or future health status, medical conditions, or the use of health care services. Such research also examines issues related to the health-care-seeking behavior of individuals, the need for health care, the organization and financing of health care, and the impact of health care on other areas. The future of health services prevention research in areas other than alcohol-related ones often has been on reducing or increasing the demand for health services and emphasizing prevention activities that are clinically based. However, on the whole, prevention has been a seriously understudied area within alcohol abuse and health services research as alcohol problem prevention goes far beyond clinical systems.

Health services considerations of treatment and prevention with attention to alcohol abuse should at the outset require an evaluation of both effectiveness and cost. *Effectiveness* is the potential to reduce an existing problem or to prevent or reduce the likelihood of a future problem so as to reduce future demand for health services. *Cost* is the monetary value of resources required to provide the service. The value or benefit to the individual and society of the effects achieved also can be measured, if appropriate, in monetary terms (ie, the social or economic value assigned to the effects). For example, one can measure benefits by estimating the value of lives saved, of improved work performance, or of averting alcohol-involved traffic crashes.

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Cost-Effectiveness of Alcoholism Treatment

The treatment of alcoholism has, in the past 15 years, been subjected to more and more controlled clinical evaluations. The evaluations usually focus on treatment effects. Effects are defined in terms of patient outcomes, usually changes in drinking behavior. There have been a number of treatment effectiveness studies, but few have considered the cost of treatment.[1,2]

Holder et al[3] completed a first approximation of a cost-and-effect analysis for alcoholism. In their analysis, they combined average unit cost per treatment modality (based on the least expensive appropriate type of facility in which the treatment modality could be delivered) and a weighted number of positive controlled effectiveness studies. They concluded that increased alcoholism treatment cost was not positively related to treatment effectiveness and that lower-cost treatment could have a significant effect on reducing drinking. Finney and Monahan[4] reported similar results

There have been a number of cost-benefit studies over the past 20 years where benefit was defined in terms of future medical care dollars saved. Jones and Vischi[5] and Saxe et al[6] provided the first reviews of such studies. Both concluded there was initial evidence that alcoholism treatment could reduce the costs of other types of health care. A review by Holder[7] reached a similar conclusion, based on the salient research of the past 20 years concerning the costs and benefits of alcoholism treatment.

One advantage that treatment enjoys vis-à-vis prevention is that researchers can determine the unit cost of service for each patient; thus, total treatment costs can be determined. Unit cost measurement is much more difficult for prevention. Prevention is often cited as a public policy goal of government, but the cost to implement policy and achieve the goal is quite diffuse and difficult to measure. However, there is no reason why prevention costs should not be assessed.

Effectiveness of Prevention To Reduce Alcohol Problems

Alcohol-involved problems are those that are both (1) chronic (resulting from long-term heavy drinking) and (2) acute (resulting from drinking in a high-risk situation). Alcohol use is unique among many public health problems in that many alcohol-involved problems are acute (in the moment) problems related to drinking (eg, drinking and driving crashes, intoxication, falls, burns, drowning, violence, etc). Acute problems attest to the unique potential of alcohol to produce impairment, increase the risk of health and safety problems, and drive up demand for emergency and long-term health care.

The prevention of acute drinking events is at the core of many effective alcohol problem prevention programs (eg, drinking and driving enforcement, responsible beverage service, keg registration, reducing service to intoxicated customers at bars and restaurants, alcohol outlet density limitations, restrictions on days and hours of alcohol sales, and reducing underage alcohol access at retail establishments and in social contexts). When prevention efforts can alter heavy or high-risk drinking behavior, a reduction in the risk of alcohol-involved problems can result. For example, by reducing the frequency of high-volume drinking prior to driving, one can reduce the risk of alcohol-involved crashes. Increased and highly visible drinking and driving enforcement can increase the perceived risk among drivers of arrest for drinking and driving, thereby directly reducing drinking in conjunction with driving. Currently, such a prevention measure is rarely evaluated in terms of reduction of emergency or trauma care.

Prevention effects also can be evaluated in terms of distal outcomes (ie, effects on health services demand or utilization). For example, reduced alcohol-involved traffic crashes can reduce the demand for emergency medical services. Similarly, a prevention effort to reduce chronic alcohol consumption of heavy-drinking individuals can reduce their risk of incurring illness resulting from long-term exposure to ethanol, thereby lowering demand for health services.

The causal chain linking drinking to health services demand is complex. For example, the distribution of driver blood alcohol concentration (BAC) on the road during any day produces a number of

alcohol-involved traffic crashes for that day. This distribution can be altered by prevention activities such as driving under the influence (DUI) enforcement, restrictions on the sale of alcohol, and server intervention. As the distribution on the road is altered (ie, fewer drivers on the road with alcohol in their blood; in particular, fewer drivers with high BAC), the number of alcohol-involved traffic crashes can be expected to decline. A BAC distribution is a risk distribution; that is, associated with each BAC level there is a probability of producing a crash and an associated demand in medical care.

Prevention Strategies: Activities, Programs, and Policies

Prevention can be expressed in three forms: activity, program, or policy. An *activity* is any action or service provided within a larger structure or program where the prevention activity is but one of the possible services offered. For example, a physician's brief intervention is an activity or service provided within the context of the overall primary health care delivery system. A *program* is a specific and purposeful collection of activities or services with the intent to reduce future alcohol-involved problems. For example, a server intervention program is a specifically defined effort to reduce the level of impairment of customers leaving a licensed bar or restaurant. A *policy* is a formal structural change (built into an organizational, legislative, or cultural change) intended to alter the way in which processes or procedures are carried out, or setting bans on or regulations concerning alcohol. A policy may include laws, rules, regulations, and organizational practices (eg, laws against drinking and driving, restrictions on number and location of alcohol beverage outlets, alcohol excise taxes, and priority given by local police to DUI enforcement).

Within a health services research context, alcohol-involved problems become intermediate variables. Intermediate variables are those factors that alter the distal outcome, which within health services can mean utilization of health care services. The number of alcohol-involved traffic crashes (intermediate variable) produces a certain utilization of emergency health care and associated costs (distal outcome). Therefore, lowering the number of intoxications or impaired drinking events can result in fewer traffic injuries, which, in turn, can reduce the demand for emergency health services. Likewise, as a result of early intervention by a primary care physician a heavy drinker can reduce his or her consumption or even begin to abstain, potentially preventing future damage to the health of the patient as a result of chronic exposure to ethanol, and, in turn, reducing future demand for outpatient and inpatient medical care. Thus, intermediate variables can be problems associated with either acute or chronic drinking. Prevention is aimed at the intermediate variable; the distal outcome is health care utilization.

Prevention within Health Services Research

Most prevention efforts directed at reducing alcohol problems are not clinically based. Likewise, they have not been directly associated with a reduction in demand for clinical health services. For example, an increase in the retail price of alcohol via a higher alcohol excise tax has the potential to reduce overall consumption of alcohol and, based on research,[8] the incidence of fatal alcohol-involved traffic crashes and cirrhosis deaths. Thus, changes in health care utilization and cost in response to traffic injuries and the treatment of liver disease caused by long-term chronic drinking are themselves health services research.

Alcohol prevention within health services research can be defined as the intentional study of prevention activities or policies in terms of their potential to reduce the future demand for health services. Thus, research on intentional and planned efforts or on unintentional efforts to reduce future health care utilization (and thus costs) is defined as prevention within health services research, whether or not reducing utilization of health care was the original intent of the prevention strategy.

If a physician treats a disease, is he or she reducing future health problems through this treatment or only addressing the immediate health condition of the patient, regardless of the future? The potential

in current treatment to reduce future health problems (and thereby reduce future demand for health services) is often called tertiary prevention. If the treatment actually reduces future problems and this can be documented, then the treatment could be defined as prevention.

Next, consider education. If giving educational materials or classroom instruction to school children reduces future drinking problems by delaying the onset of drinking and by reducing heavy drinking including intoxication, then future utilization of health services could be reduced. Counseling is somewhat more complicated. If the counseling of a patient concerning his or her drinking by a health provider actually decreases drinking, then the provider is carrying out the same role as any educator.

A clinical education program to reduce drinking by pregnant mothers in order to reduce incidence of fetal alcohol syndrome (FAS) and the future demand for health care for FAS infants can be defined as prevention. Early identification by physicians or employee assistance programs (EAP) of heavy (likely dependent) drinkers in order to refer patients/employees to treatment is not necessarily prevention. Rather, it is simply early identification and referral to treatment if the major outcome is only to get patients or workers into treatment. However, if such early-stage treatment reduces subsequent future health care utilization, then one can argue that the program also has a prevention aspect.

A physician counseling a patient about current drinking practices shares the same objective as an alcohol beverage server intervening with customers at a bar or restaurant. They both work to reduce high-risk drinking. The physician seeks to reduce a patient's drinking. The server seeks to reduce the customer's drinking in order to reduce acute alcohol impairment, with a potential reduction of accidental injuries and demand for emergency health services. Both might have a prevention effect, but server training in intervention could be expected to have a more immediate effect on health care demand than physician counseling. While health services improve the health status of individuals, so do other public health prevention strategies including restrictions on alcohol access, school education, and server intervention.

Utilization and Costs of Alcohol Abuse Prevention

Utilization refers to the consumption of services. Utilization can be applied to prevention; in fact, in the end, it is impossible to evaluate prevention without analyzing its cost. Utilization measures describe the size, extent, exposure, or use of prevention activities, programs, or policies. Utilization data enable a determination to be made of access to prevention services (eg, screening and diagnosis of problem drinking as a part of primary health care). While utilization typically refers to a level of use of a service by a target population (eg, number of inpatient days), it also can refer to overall exposure or opportunity for a general population (eg, likelihood of detection for drinking and driving by police among all drivers who are drinking).

The determination of utilization for alcohol policy represents a special research challenge. One possible approach to utilization in alcohol policy is to determine the level of exposure of the policy in terms of people affected. For example, a policy raising the minimum drinking age from 18 to 21 years directly affects the potential youth drinking population from ages 18 to 20.

Cost derives from both service utilization and program or policy cost. Cost can be determined in terms of (1) direct costs and (2) indirect or larger social costs. Direct costs are costs that can be assigned to the activity, program, or policy as well as to health services that could be affected. These costs can be based on either average units of cost or the actual documented costs.

The costs for alcohol policy are a special challenge to determine because (1) many costs associated with policy are hidden or not easily documented and (2) there are substitution costs. Existing personnel often staff public policies, and the administration of a policy competes with other priorities. For example, the police time to enforce alcohol laws competes with other police priorities. The total cost of a prevention policy can be expressed in terms of the professional time to design, implement,

and train for such a policy; the staff costs to implement; and the time required to enforce or ensure compliance. Determining the cost of design, implementation, and maintenance of prevention policy represents a difficult challenge for researchers since the direct costs for policies are often hidden in existing administrative budgets or are hard to assess in political processes involved in actually bringing about a prevention policy. For example, the cost to design and implement a new city ordinance that restricts the density of alcohol outlets could include the cost to design the ordinance, obtain review and approval by the city planning commission, get the ordinance approved by the city council, and prepare the administrative procedures for review and approval once the ordinance is approved.

A broader analysis of prevention could include the larger social costs associated with alcohol problems in conjunction with health services. The issue of social costs and benefits can involve benefit analyses of reduced social and health costs comparing one prevention strategy with another. The larger social costs of alcohol problems have been addressed by a number of prior studies. Their perspective, considering the larger picture of costs to society, provides an important model for future studies of costs of alcohol problem prevention within health services research.

Kenkel[9] gives a particularly detailed discussion of social costs in terms of alternative policies to prevent drinking and driving. He presents an economic theory of deterrence of drunk driving and the associated costs to a convicted drunk driver. He also reviews the alternative strategy of using the retail price of alcohol as a means to accomplish similar objectives. Kenkel develops an econometric model of the relative costs of stricter deterrence and alcohol price increases and their effects on reducing drunk driving events. While the costs used in these analyses do not include costs for health service, they do include estimated costs for actually carrying out alternative alcohol problem prevention strategies. As a result, the cost to implement, enforce, and convict drunk drivers is balanced against the social gain in reduced drunk driving.

Kenkel[10] uses a similar approach to derivation of social costs in an analysis of the minimum drinking age compared with levying a special teen tax on alcohol purchases. In his analysis, he concludes that better effects could be achieved in terms of reduced drinking among those under age 21 through higher alcohol prices than through a legal age. Again, his analysis provides a model of the consideration of consumer costs to purchase alcohol and the public revenues derived from special taxation balanced against the social gains in terms of reduced alcohol consumption by youth.

Saffer and Chaloupka[11] examined the social cost value of alcohol tax equalization, that is, when all alcoholic beverages are taxed (and implicitly priced) according to the absolute alcohol content. Through an econometric model of alcohol demand, they found the optimal tax on each beverage (beer, wine, and spirits) based on the assumptions of demand they presented. This review illustrates an analytic approach to examining the social value of various alcohol price levels to reduce the cost to society of alcohol abuse.

Pogue and Sgontz[12] distinguished the costs for alcohol problems borne by the abuser (internal costs) and those inflicted on the larger social whole (external costs). Internal costs include medical expenses, lost income, increased health and auto insurance, and the pain and physical distress of injury and excessive alcohol use. External costs can take a number of forms including injury (and the associated medical costs) to others and property damage. The authors presented an approach to estimating health services and costs associated with alcohol abuse that includes both the costs to the abuser as well as to society.

These studies provide examples and analytic models for examining the larger costs associated with alcohol problems. They also suggest possible metrics for determining the costs and benefits of prevention efforts.

Cost-Effectiveness for Prevention

The most expensive prevention is not necessarily the most effective or the best investment; likewise, the least expensive prevention approach is not necessarily the best option. The prevention alternative

that yields the highest effect can be so costly as to be unacceptable. For example, an early identification and diagnostic program that has fine screening for alcohol problems (ie, few cases are missed) might have an operating cost that exceeds the expected savings in reduced future utilization of health services. Or, the screening effort might have no effective recovery or behavioral change program following identification; thus there would be little or no change in drinking behavior simply as a result of screening. In this case, the cost of the screening program would be incurred, but little effect (in terms of reduced drinking problems and reduced demand for medical care) would be achieved.

Thus, to determine cost-effectiveness is to determine the outcome of a prevention activity, program, or policy relative to the cost required to achieve the outcome. (Cost/effect methods and analyses are discussed elsewhere.[13–15]) Similar techniques can be applied to the evaluation of prevention within health services research in general. The health services outcome also may be measured by cost and utilization (ie, cost changes in health services from lower utilization [cost derived from annual inpatient admissions or length of stay] as a result of prevention that has its own unique cost). The effects of prevention can be expressed in fewer problems resulting from chronic or long-term exposure to ethanol and problems resulting from acute or short-term exposure to ethanol and the associated impairment and intoxication. The outcome measured is reduction in future health care services (eg, hospital admissions for cirrhosis [chronic] and use of emergency department services [acute]). Analysis encompasses that which is appropriate to examine cost and effect (cost of prevention relative to its actual effect; for example, reduction in hospital admissions for treatment of cirrhosis) and cost and benefits (utilization reduction and cost savings in emergency department care relative to the cost of the prevention program).

Public Health and Safety Education

Health education has been a popular health services approach to prevention of alcohol problems. Such education reflects societal values and concerns about personal behavior that has potential health and safety risks (eg, smoking). For alcohol, the federal government now requires a warning label on all alcohol products. There are at least three rationales for warning messages: (1) to acknowledge the government's recognition of health and safety risks associated with alcohol as a commercial product, (2) to inform the public that these risks exist and to reduce the specific alcohol-involved problems cited on the label, and (3) to be part of a comprehensive alcohol policy to reduce problems. Hilton[16,17] reviews existing research on warning labels.

For warning labels to be successful, people must read them and be aware of their message. Hankin et al[18] observed a lower recognition of the warning among women of child-bearing age among black, inner-city, pregnant women. Mazis and colleagues[19] found slow diffusion of the warning label in Gallup Polls taken between 1989 and 1991. For the warning to reduce risk, people must be concerned about the content of the warning and actually change their drinking behavior. Greenfield et al[20] found an increase in self-reported limits on drinking among women of child-bearing age in the national surveys. Hankin et al[21] found little increase in the perceived risk of drinking during pregnancy among pregnant women in prenatal clinics. They also found a 7-month lag in the impact of the warning label on the drinking of pregnant women. Among pregnant drinkers, there was a significant reduction in alcohol consumption among light drinkers but no change among heavy drinkers. This finding is similar to the conclusion of Parker and coworkers,[22] who found no change in drinking and driving behavior among self-reported at-risk drinkers.

Greenfield et al[20] found that the proportion of people who reported deciding not to drive after "having too much to drink" rose from 35% in 1989 (pre-label) to 43% in 1990 (post-label). In particular, young males increased from 72% to 81%. Andrews et al[23] found that college students found the drinking and driving warning to be believable. Overall, alcohol container warning labels have achieved greater awareness over time in the United States, particularly among those drinkers most at risk for the alcohol-related problems noted in the warning.

Publicity alone rarely produces lasting changes in safety behavior.[24] The best understanding of effects from media attention to DUI enforcement can be seen as an interaction between mass media information and the personal experience of drivers. In his report on the British Road Safety Act of 1967, Ross[25] noted that the public was initially led to believe that the probability of being tested for alcohol and arrested was much higher than it actually proved to be. He states: "It seems reasonable to me to ascribe [the subsequent reduction in effectiveness of the law] to the gradual learning by U.K. drivers that they had overestimated the certainty of punishment under the law."[25(p89)]

Worden et al[26] report an alternative finding after conducting a public information campaign using BAC estimation cards that told drivers the steps for determining their own BAC. These "Know Your Limit" cards were widely distributed in an experimental community. Using roadside survey and community survey data, they found that following the campaign only 0.06% of drivers in the experimental community were over the legal limit compared with 3% of the drivers in the control community. However, the study design was weak because no pre-intervention baseline existed.

Educational strategies can play at least two important roles in a comprehensive prevention program. First, education can increase public awareness of the relationship between a specific health problem (eg, birth defects related to drinking by a pregnant woman) and alcohol itself. This relationship, which may seem so obvious to scientists involved in the study of alcohol and to public health advocates, is simply not understood by either the general population or women of child-bearing age. Health education as part of comprehensive prevention has the potential for synergy with other strategies. For example, discussions by physicians with pregnant women about personal drinking behavior can be enhanced by the presence (and content) of the alcohol warning label.

A warning label also reinforces environmental prevention strategies such as server training and server intervention. The strategy is to train both beverage servers and managers and to establish responsible beverage serving policies in bars and restaurants.[27] It is designed to reduce the level of alcohol impairment and intoxication of customers, but servers could use it to caution pregnant women about heavy drinking.

The research summarized above supports optimism that warning labels can increase awareness of alcohol risks among women of child-bearing age, drinking drivers, and the general public. However, the labels alone may not reduce demand for health services.

Previous Research on Health Services Costs, Utilization, and Cost-Effectiveness

Cost-effectiveness evaluations of prevention efforts have a relatively short history. Recently, there have been proposals to do them and statements about the need for cost-effectiveness analyses in prevention for the same reasons as studying the cost-effectiveness of alcoholism treatment. (See discussions by Godfrey[28] and Godfrey and Maynard.[29]) One handicap in linking prevention to health services is the lack of consistent measurement of cost for medical care.

One example of measurement of such cost is provided by Streff et al.[30] They developed an analytic approach to determining the cost to the state of Michigan of traffic crashes and crime. A unit cost per injury was calculated that included an estimate of medical treatment costs related to injuries and violent crimes. Comparing the benefit (expressed in part as reduced medical costs for injury treatment) with the cost of achieving this reduction, a policy maker can determine which program offers the best effects for the cost. Miller and associates[31] provide cost estimates per type of injury incurred in a traffic crash including spinal cord, head/brain, lower extremity, upper extremity, trunk, face/neck, flesh/external, and all injuries. The total cost per injury includes average cost of hospital care (expected number of days times the average cost per day) plus, where appropriate, the average cost per case of non-hospital care. Miller[32] also examines medical costs associated with traffic crashes (whether alcohol is involved or not) and provides estimates of injuries from traffic crashes including

medical, ancillary, and emergency costs. In addition, the study addresses lost wages and household production, workplace disruptions, insurance administration, legal proceedings, and lost quality of life.

Miller and coworkers[33] derived potential health-related costs for death and nonfatal physical and psychological injury resulting from violent crimes. They used the National Crime Survey (NCS) and the Detailed Claims Information (DCI) database of the National Council on Comprehensive Insurance (NCCI). While this study is not specific to alcohol-involved intentional nonfatal injuries, it shows methods that can be used to derive estimates of medical care costs associated with alcohol-involved violent crimes.

For chronic alcohol-involved problems, preventive strategies (usually early intervention, diagnosis, and treatment or even brief intervention) have been evaluated in terms of changes in drinking status or increases in abstinence. Tolley and Rowland[34] provide one study of cost-effectiveness of early screening for alcohol problems in a general hospital in England. They examined the relative cost of using physicians, nurses, or a specialist worker to screen all medical and orthopedic admissions over a 21-month period. The effects were defined as rates of identification of problem drinking patients. Tolley and Rowland found that a greater case identification rate could be achieved with a specialist worker but at a greater cost. Their study did not examine the effects of identification on future hospital admissions.

One effort to estimate the costs and benefits of prevention effects on chronic ethanol exposure and associated health care costs is provided in a report by Miller et al.[35] They estimated the effects and costs of identification and brief intervention on heavy drinkers and early diagnosis on heavy dependent drinkers. Effects were assessed in terms of reduced health care costs for treatment of the chronic use of alcohol. Since such effects of secondary and tertiary prevention have not been derived from controlled research, the authors used published research on health care reduction achieved by treatment of younger diagnosed alcoholics.

For acute outcomes of problem drinking, injuries are an appropriate measure for alcohol problem prevention research in general, and there are many prevention studies in which the incidence of injury is a key outcome variable. An example of a cost-benefit analysis of the relative merits of a prevention program in terms of health services effects comes from an injury prevention counseling program for pediatricians.[36] This program used previously published work on the effectiveness of primary care–based physician counseling for parents to prevent injuries to children and compared the costs and estimated monetary value of safety counseling targeting children up to age 5. The major aspect of the monetary assessment of injury reduction was lower medical and rehabilitation costs as a result of changes in injury levels. A study by Miller et al[31] suggested that an assignment approach to injury health care demand involving alcohol could be used. In this formulation, the probability or likelihood for each injury (by type and severity) to require hospital and other medical care is derived. Thus, if a prevention strategy can be shown to affect specific types of injuries or injuries in general, then an attribution technique for assigning potential lower medical care costs could be applied.

There are very few studies of the cost-effectiveness of alcohol problem prevention. Levy and Miller[37] completed a cost-benefit analysis of an alcohol prevention project. They assessed a program to enforce local laws against service to intoxicated patrons at bars and restaurants in Ann Arbor, Michigan. Police (in plain clothes) went to licensed establishments, observed serving practices, and noted instances of alcohol service to intoxicated patrons. Rather than take enforcement action on the spot, these law officers wrote a letter informing the manager/owner of the establishment of their observations and future intent to revisit the establishment. Levy and Miller determined the dollar benefit of reduced crashes including a cost estimate for medical care. Levy and Miller's estimates enabled them to assess the cost of the prevention program relative to its benefit (expressed as cost savings). A measure of the effect was reduced medical costs for nonfatal injury. The results showed that the cost of the program (using plain-clothes officer time) was lower than the cost of DUI enforcement and medical care costs before the program. Thus, a cost saving was achieved.

Miller and colleagues[38] presented a cost-effectiveness analysis of police checkpoints for identifying drinking drivers. They calculated and compared the cost savings in medical care resulting from fewer alcohol-involved injuries from traffic crashes. The cost of officer time and other associated costs were used to determine prevention program cost. As in other work by Miller and colleagues, the average expected utilization of emergency care and associated costs expected from traffic crashes were used to determine the changes in health services resulting from the enforcement program. The program cost was offset through expected lower medical care costs.

Mercer et al[39] conducted a cost-benefit analysis of roadside drinking and driving enforcement that was carried out as a 5-month intensive policy effort. This analysis considered the relative costs of enforcement against the estimated values of traffic crashes reduced. In like fashion, Miller and coworkers[38] estimated that sobriety checkpoints near bars between 11 PM and 2 AM could reduce alcohol-related fatalities by 15% with an average cost savings of at least $50,000 per checkpoint, including over $3,000 in medical care costs.

Miller and colleagues,[40] in evaluating the costs and benefits of alternative prevention strategies targeting youthful drinking drivers, found a cost-benefit ratio of 21 for state zero-tolerance laws (which specify low blood alcohol levels for drivers under age 21) where medical care costs alone exceed the cost of enforcement. These same authors also found that a provisional or graduated-age driver's license for drivers under 19 had a cost-benefit ratio of 7.2 based on a 5% to 8% reduction in youth traffic fatalities and a 2% reduction in alcohol-involved fatalities.

Holder et al[41] provided an example of the potential cost-effectiveness of local policy-based prevention based on a national community prevention trial. The trial involved three experimental communities along with matched comparison communities. (A description can be found elsewhere.[42]) The goal of this trial was the reduction of alcohol-involved injuries, which had a direct relationship to demand for health care services within the three communities. The Community Trial Project focused on community priorities, resources, and structural changes and was purposely designed to be low cost (relative to other community prevention efforts). Across all communities over the first four intervention years of the project, the net reduction in alcohol-involved traffic crashes was 78 crashes.[43] Assuming an average cost of $39,905 per crash (an estimate based on medical, legal, and insurance costs as well as lost wages during rehabilitation but not lost productive years due to early death[32]), the savings from these 78 fewer alcohol-involved traffic crashes in the three experimental communities relative to their matched comparison communities was $3,112,590 in US currency ($39,905 US dollars per crash $\times$ 78 crashes). Subtracting the total cost of the intervention, yields a net total savings of $2,032,590. Thus, every dollar invested in this Community Trial Project returns $2.03 in savings, just from reduced traffic crashes alone.

It should be noted that this analysis is a simplistic cost-effectiveness analysis. The costs shown do not include opportunity costs such as taking law enforcement officers away from other duties to perform DUI enforcement. There is no estimate of the contributed value of the time of many community volunteers. This illustration also does not include the cost of data collection for evaluation.

Only limited research exists on utilization and cost, cost-effectiveness, and cost to benefits of alcohol problem prevention activities, programs, and policies in general, and the effects of prevention on health services demand in particular. But as this review demonstrates, a few research studies examine the cost or utilization of health services associated with changes in alcohol-involved problems. The existing literature provides models and approaches that can be used to determine cost and utilization of prevention as well as health services affected by prevention.

Final Observations

The development of alcohol problem prevention activities, programs, and policies is rarely based on scientific evidence. Public and private agencies fund many prevention programs with little scientific

evidence of potential effectiveness. There is little attention to the cost of prevention activities and, more important, to the relation of cost and effectiveness.

The lack of a scientific basis for prevention activities does not result from lack of scientific evidence. In the area of alcohol policy alone, a substantial body of research literature exists. Edwards et al[44] and Holder and Edwards[45] provide reviews of such alcohol policy research. The problem is lack of desire to provide scientific justification for any prevention activity that uses human and monetary resources—and the lack of demand by funders that program planners provide such justification.

All alcohol problem prevention programs, especially those linked to health services, should be required to demonstrate feasibility of effectiveness before any funds are committed to them. The best evidence would be prior scientific studies (evaluations) that have been replicated in multiple conditions and have consistently demonstrated the effectiveness of the proposed prevention activity or policy. Short of this standard, the next level of evidence would come from promising scientific research (perhaps not substantially replicated) and theory that support the potential effectiveness of the prevention activity. The lowest minimum level of support should be a clear statement of the theory or conceptual model on which the prevention effort is based. This minimum level also should require that scientific evidence from basic research support the theoretical basis for projecting the program's effectiveness.

Many prevention planners will object to such requirements and appropriately point out that not all of the necessary research has been completed. While prevention action cannot wait until all the research has been done, this does not remove responsibility for designing and evaluating programs that scientifically demonstrate the potential effectiveness of prevention efforts.

In the end, alcohol prevention programs and policies are made within political processes that reflect popular interests, values, and beliefs. Scientific evidence can be used only to inform the public debate. Science cannot make the final decision. However, even if final decisions about prevention efforts are subject to politics, this does not rule out the need to require that the best available scientific evidence be used to inform such decisions.

Implications for Behavioral Health Services

Within health services research, it is essential to analyze the costs of alcohol abuse prevention efforts in terms of their demonstrated effectiveness in reducing health services demand. This priority requires documenting the true cost of design, implementation, and operation of a prevention program or policy. While public and private funding agencies usually require proposed budgets before they commit their support to a prevention program, in practice actual costs of programs are not usually monitored or documented.

Prevention programs or policies with health services implications can document their actual effectiveness in reducing demand for services. A change in attitude or support for a prevention effort is not evidence of effectiveness. Increased numbers of participants in meetings, exposure to communication and information, or increases in knowledge levels are not evidence of effectiveness in reducing alcohol problems. While a requirement to show effectiveness would place a considerable intellectual and economic burden on some programs, one cannot escape the need for such a demonstration of effectiveness.

The joint consideration of the cost and effectiveness of prevention programs can help researchers determine the relative cost-effectiveness of a variety of programs to reduce health care utilization (eg, by reducing alcohol-involved traffic crashes, thereby lowering demand for emergency services). Low-cost alternatives may have high or low effectiveness and should not necessarily be implemented on the basis of cost alone. On the other hand, expensive prevention programs should not be presumed to be more effective. Even if expensive programs are effective, the relative cost to achieve reductions in alcohol-related problems should be considered along with other lower-cost alternatives with similar potential effectiveness.

There are some special challenges for health services research with reference to alcohol abuse prevention. Some of these challenges include the following:

- Many effective alcohol prevention strategies are not clinical or service based, and a large number utilize public policy. This means that the effects of such prevention (and its associated costs) cannot be easily assigned to a specific target population.
- The link between alcohol prevention and demand for health services is not often explored in research practice. As such, it is not a familiar or popular perspective for health service researchers. Acceptance of this perspective may take some time.
- Alcohol abuse prevention addresses both acute and chronic drinking. Each has implications for health services demand (eg, acute problems predominantly use emergency or trauma care and chronic problems will use more traditional outpatient and inpatient medical care). These distinctions can create special problems in isolating unique effects in alcohol prevention.

However, in a time of scarce resources for all health programs, alcohol abuse prevention should be studied with the same care and rigor as is treatment in order to determine the best return for investment. Such a need is critical because public revenues fund many prevention activities, programs, and policies for reducing alcohol-involved problems. Since so little research has been conducted on alcohol-problem prevention within health services research, little is known about potential net return on investment (ie, the cost of prevention in relation to its effectiveness in reducing problems that create demand for health care). Now is the time to build this knowledge.

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