

**A GENERAL CAUSAL MODEL TO GUIDE ALCOHOL,
TOBACCO, AND ILLICIT DRUG PREVENTION:
ASSESSING THE RESEARCH EVIDENCE**

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ABSTRACT

The problems associated with the use of alcohol, tobacco, and other drugs (ATOD) exact a significant health, social, and economic toll on American society. While the field of substance abuse prevention has made great strides during the past decade, two major challenges remain. First, the field has been disorganized and fragmented with respect to its research and prevention practices; that is, there are often separate ATOD prevention “specialists.” Second, both the prevention researchers who test the efficacy of specific prevention strategies and the practitioners who implement prevention efforts often lack an overall perspective to guide strategy selection. To address these limitations, we present an ATOD causal model that seeks to identify those variables (Domains) that are theoretically salient and empirically connected across alcohol, tobacco, and illicit drugs. For the researcher, the model demonstrates important commonalities, as well as gaps, in the literature. For the practitioner, the model is a means to recognize both the complexity of the community system that produces ATOD problems and the multiple intervention points that are possible within this system. Researchers and practitioners are thus challenged to work synergistically to find effective and cost-effective approaches to change or reduce ATOD use and associated problems.

INTRODUCTION

The use of alcohol, tobacco, and other drugs (ATOD) poses tremendous health risks. According to the World Health Organization (WHO), the use of alcohol and tobacco ranks among the top 10 risk factors to good health worldwide, while illicit drugs use ranks among the top 10 risk factors to good health for developed nations [1]. In the United States, ATOD use is the single leading risk factor to good health. One quarter of approximately two million deaths each year can be attributed to ATOD use [1]. Tobacco use is responsible for more than 430,000 deaths annually, alcohol use 100,000, and illicit drug use 12,000 [2]. The total monetary cost of substance-attributable problems for both users and non-users was estimated at \$684.3 billion in 1998 [3].

In addition, substance use also often results in severe social problems. Interpersonal violence associated with substance use includes homicide, sexual assault, and domestic violence. The ramifications of child abuse and neglect resulting from substance use can have lasting effects. Crime committed in order to acquire or distribute illicit substances constitutes another serious threat to the well-being of our communities. The monetary cost of substance-attributable violent and property crime alone was more than \$42 million in 1998 [3].

During the past decade, the field of substance abuse prevention has substantially improved its understanding of key causal factors that influence both ATOD use patterns and the problems associated with ATOD use. In turn, an increased understanding of the epidemiology of ATOD-related problems have led to improvements in the development and testing of effective, evidence-based prevention strategies. These successes aside, two major challenges remain. First, the prevention field has been disorganized and fragmented with respect to its research and prevention practices. In both arenas, there are often separate “specialists” for alcohol, tobacco, and illicit drugs. This approach has led to distinct perspectives regarding the causal variables most associated with ATOD-related problems and the most effective prevention strategies that should target those problems. Lessons learned about alcohol use prevention, for example, are unlikely to be used by tobacco experts. Second, both the researchers who seek to test the efficacy of specific prevention strategies and the practitioners who implement prevention efforts often lack an overall perspective to guide strategy selection.

We seek to address these issues by presenting a general causal model for ATOD prevention. We identify variables that are theoretically salient and empirically connected *across* alcohol, tobacco, and illicit drugs. We refer to these variables (or groups of variables) as Domains and demonstrate how these Domains exist for alcohol, tobacco *and* illicit drugs. For each Domain, we provide a definition, summarize the key research that links that Domain to ATOD use and associated problems, and describe its relationship to other Domains in the model. These Domains are organized into a simple causal model that can be applied to all three substance areas.

Supporting evidence for the Domains is derived from three types of scientific research. *Descriptive and observational* research illustrates that a particular domain is generally related to the use of a particular substance or associated problem. *Associative or relational* research examines the association of one or more specific variables with ATOD use and/or associated problems. This research is usually based on data collected from one or more populations or geographic areas at a single point in time. *Intervention* research is designed to determine whether or not ATOD use and/or associated problems change as a result of altering key independent variable(s). This type of research increases our confidence that ATOD use and associated problems are linked to the specific independent variable being tested. Rather than give a definitive review of the available research, our more heuristic goal is to summarize the major findings that support the inclusion of these Domains in our model.

Numerous theories of substance use exist, many of which focus on identifying variables that influence individuals' use choices and patterns. Our goal is not to displace those theories, but rather to focus on variables that influence the use patterns and problem manifestations of populations. We seek to identify variables that are common across cultures, ages, abusers and non-abusers, albeit with specific manifestations within different populations. This type of model has been labeled a "systems" or "community systems" model in other writings [4], and we take this perspective in our article.

For the researcher, our model provides a summary of ATOD prevention research spanning several decades. Like practitioners, researchers sometimes ignore research outside of their specific areas of interest. As a result, ATOD research is often conducted in isolation, with a tendency to develop research "silos" in which commonalities across substance are largely ignored. In summarizing research across ATOD areas, the model also demonstrates important gaps in the research literature. For the practitioner, the model is a means to recognize both the complexity of the community system that produces ATOD use and associated problems and the multiple intervention points that exist within the system. Researchers and practitioners are thus challenged to work synergistically to find effective and cost-effective approaches to reduce or change ATOD use and associated problems.

OVERVIEW OF THE GENERAL CAUSAL MODEL

A diagram of the general model is shown in Figure 1. The primary purpose of ATOD prevention is to reduce substance use and the problems associated with substance use. A plethora of health, social, and economic problems result from ATOD use. Examples of such problems include traffic crashes caused by alcohol-impaired drivers, violence stimulated by either the victim or perpetrator, or lung cancer and other health problems associated with long term exposure to tobacco smoke.

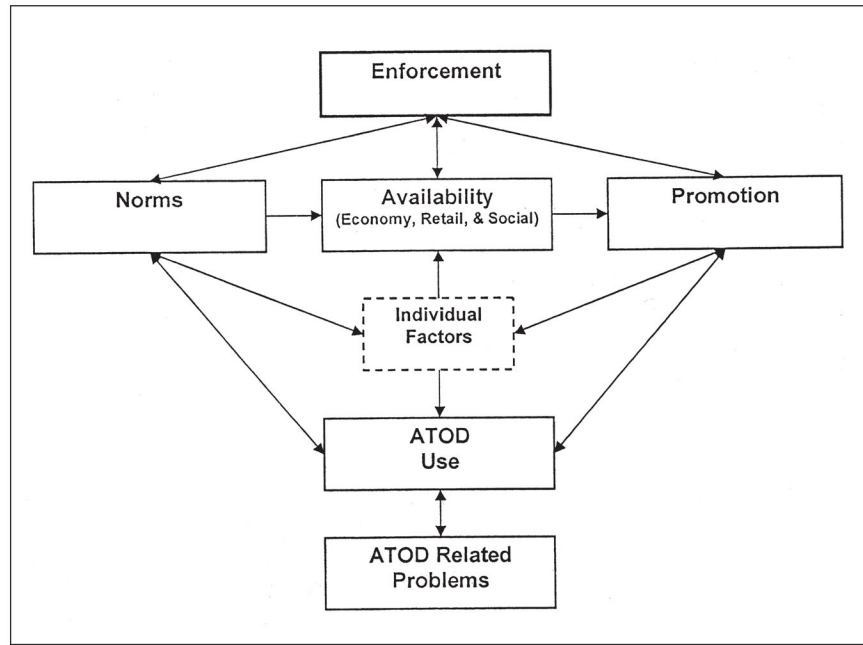


Figure 1.

Some of these problems may occur independently of substance use. For example, traffic crashes occur with no alcohol involvement, and violence is not exclusively the result of substance use. For the purposes of this model, however, we are concerned only with those problems that result from ATOD use. Use in and of itself may be defined as a problem if the actual use or type of use is illegal or undesired (e.g., use of tobacco or alcohol by underage youth or drinking and driving). In general, prevention is unable to *directly* reduce these events or behaviors. Rather, prevention works through intermediary variables to provide opportunities for intervention. In considering the choice of such variables, we note that each substance category has several such causal factors in common, even though their manifestation may vary according to the specific substance (e.g., alcohol or heroin).

At their most basic level, alcohol, tobacco, and illicit drugs are retail products subject to both supply and demand factors. The desire for substances creates demand, which stimulates supply, particularly when profit can be realized from the sale of these substances. Likewise, the potential for profit encourages suppliers to stimulate demand. One implication of the considerable prevention and epidemiological research during the past 50 years is that demand and supply are inexorably

intertwined (i.e., they form a dynamic ATOD system) [4]. Historically, however, prevention specialists have given more emphasis to demand factors, often to the exclusion of supply. Our general model includes both aspects, but seeks to balance the lack of attention that supply has traditionally been afforded in prevention practice.

In Figure 1, Availability represents one of the key components of the supply of substances. Without availability of particular substances, there can be no use or associated problems. There are three specific sub-domains to Availability: 1) Economic Availability (price); 2) Retail Availability – the accessibility of ATOD from retail sources (e.g., a liquor store); and 3) Social Availability – ATOD accessibility from non-retail sources (e.g., family and friends).

A significant motivation for making substances available through retail markets is profit. To increase profit, manufacturers and retailers attempt to increase demand through the advertising and promotion of their products. Therefore, Promotion is also included in Figure 1. Historically, there are informal standards or values (“norms”) regarding the acceptability or unacceptability of certain behaviors, including substance use. These informal norms may be codified into concrete expressions such as public policies, laws, and regulations, which may affect Availability, Promotion, and/or directly define undesired or illegal ATOD use. These standards can shape both ATOD demand and supply. In Figure 1, these standards, whether informal or formal, are referred to as Community Norms.

While laws and regulations that seek to limit availability, regulate promotion, or reduce undesired use can be effective on their own, much of their potential is directly related to the enforcement of their provisions. Therefore, a major domain affecting Availability, Promotion, or directly affecting undesired or illegal ATOD use is the formal Enforcement of these laws and regulations. Again, enforcement can affect either the demand or supply for substances, as shown in Figure 1. Considerable research in the etiology of substance use and abuse has focused on individual characteristics, including genetics, values, attitudes, and social associations as they contribute to individual substance use decisions. These factors affect demand and are represented in Figure 1 as Individual Factors.

Figure 1 illustrates the general system of ATOD use and problems. We attempt to illustrate that such a system is dynamic (i.e., changes over time such that variables can affect one another) and adaptive (i.e., changes in one part of the system can stimulate adaptive responses in another). To reiterate, our goal is to identify those common variables or groups of variables that are important contributors to substance use and associated problems and which can be shown to apply across the ATOD categories. In the following section, we review each domain, providing a brief description of the domain and summarize the key research evidence supporting each domain’s inclusion in the model across the three drug categories.

Availability

Without availability, there can be no use and associated problems. As a general rule, when a substance is inexpensive, convenient, and easily accessible, people are more likely to use it, which increases types and rates of associated problems. Conversely, when a substance is expensive, inconvenient, and inaccessible, people are less likely to use it, and problem types and rates are lower. We address the general area of availability by distinguishing between Economic, Retail, and Social Availability.

Economic Availability

Economic Availability refers to the price that must be paid to obtain alcohol, tobacco, and illicit drugs. All goods are sensitive to price. This sensitivity is called “elasticity,” which provides a metric of responsiveness to price changes (the percent change in quantity demanded resulting from a one percent change price). Most of the research on the effects of price on ATOD use and problems consists of econometric analyses to empirically determine price elasticities using time series data. In some cases, estimates of the potential benefits of increased prices have been derived.

Alcohol—Empirical evidence has consistently shown that higher alcohol prices are associated both with less alcohol consumption and fewer associated problems. This relationship has been noted in international studies [5, 6] and those conducted in the United States [7-10]. Studies show that youth are generally more price sensitive than adults, primarily because they have less disposable income, tend to discount the future, are more influenced by peer pressure, and are less likely to be addicted than adults. There is considerable debate on whether non-abusive drinkers are more price sensitive than abusive ones. Manning et al. reported that moderate drinkers were more price responsive than light and heavy drinkers [11], while Kenkel found heavier drinkers were more sensitive to price than lighter drinkers [8].

Based upon empirically determined price elasticity estimates, studies have shown that increases in alcohol taxes reduce alcohol-related problems, including drinking and driving and violent and nonviolent crime [12-15], and work loss days from nonfatal injuries.

Tobacco—As with alcohol, research has consistently found that higher prices are associated with less use and fewer problems. This relationship has been found in both international studies [17, 18] and from the United States [7, 9]. Whether or not young smokers are more responsive to price has been debated in the literature, and the range of estimates varies. In a recent review of the literature, Hopkins et al. found that adolescents and young adults showed strikingly similar median estimates and ranges of both prevalence and consumption price elasticities to those of adult smokers [9].

Recent tobacco price increases have provided empirical tests of price effects, and studies have found that increased price leads to decreased use [19, 20]. Recent investigations have found that higher smokeless tobacco taxes also reduce smokeless tobacco use [21, 22].

Illicit drugs—Similar to alcohol and tobacco, empirical evidence has generally found that higher illicit drug prices are associated with reduced consumption. Studies using data from the System to Retrieve Information from Drug Evidence have found that an increase in price yields decreased use of marijuana [23, 24], cocaine [25-27], and heroin [26, 28, 29].

Price and cross-drug relationships—An important empirical question is how price changes for one substance affect the use of others. A limited number of studies have produced mixed results [25, 28, 30-32]. DiNardo and Lemieux found that marijuana decriminalization had a significant positive effect on the prevalence of alcohol use by high school seniors [30]. Chaloupka and Laixuthai reported that the frequency of drinking and the probability of heavy drinking were inversely related to beer prices and positively related to the price of marijuana [31]. Pacula found that, for both men and women, higher beer taxes reduced the consumption of both alcohol and marijuana, implying a complementary relationship [32]. Saffer and Chaloupka found consistent evidence of a complementary relationship across alcohol, marijuana, cocaine, and heroin [28].

Summary—Taken collectively, econometric research provides strong evidence that ATOD price is strongly associated with ATOD use and problems. Studies have established that higher prices are associated with lower use for alcohol, tobacco, and illicit drugs.

Retail Availability

Like other goods, ATODs are bought and sold through retail markets. In the case of alcohol and tobacco, most sales occur through formal retail markets (e.g., stores and restaurants), although a certain amount of sales occur in informal, and sometimes illegal, markets (e.g., private homes and unlicensed establishments). In the United States, illegal drugs are sold primarily through informal markets. In addition, some drugs, which can be legally sold, are used by groups or in manners that are not sanctioned by the legal market (e.g., abuse of prescription drugs). Restrictions on retail availability are intended to limit consumer access to products or to regulate the context in which products are used. Studies of specific retail changes provide opportunities to examine the relationship between retail availability and substance use and related problems.

Alcohol—Studies that look at variations of restrictions on availability or efforts to change the retail availability of alcohol have generally found that reduced retail availability results in lower alcohol consumption and associated problems.

Changes in general alcohol availability in Iceland [33], Poland [34], Sweden [35], and Greenland [36] have been associated with changes in drinking. Other studies, described below, look at specific efforts to restrict retail availability in the United States and internationally.

Outlet densities—Retail outlets can be sources of alcohol for all ages. Gruenewald et al. estimated that a 10% decrease in the density of alcohol outlets would reduce consumption of spirits from 1% to 3% and consumption of wine by 4% [37]. Treno et al. found that higher outlet density was positively related to drinking and driving among licensed youth drivers and negatively related to riding with drinking drivers among youth who did not have driver licenses [38].

Minimum drinking or purchase age (MDPA)—MDPA laws are intended to reduce retail access to alcohol by specifying the age at which one can purchase and consume alcohol legally. Studies of MLDA changes in the United States and internationally provide strong evidence that lower legal drinking ages reduce alcohol-related crashes [39-43]. Higher legal drinking ages have also been associated with reductions in other injuries [44, 45].

Hours and days of retail sale—The length of time alcohol is sold (measured in legal hours and/or days of sale) during a week can affect alcohol use and associated harm. Significant increases in restrictions on time of sale have been associated with decreased drinking and less restrictions with increased consumption and problems [46-50].

Responsible beverage service (RBS)—RBS has the potential to decrease service to intoxicated patrons and underage persons in bars, restaurants, and off-license establishments. RBS programs have been found to reduce the number of intoxicated patrons leaving a bar [51-56], reduce the likelihood of alcohol sales to minors [57-60], and decrease the number of car crashes [61].

Tobacco—While there are few experimental studies of the relationship between retail availability and overall smoking, a number of naturalistic studies provide evidence that global tobacco availability, through international trade agreements, the opening of new international markets, and increased restrictions and regulations on the tobacco industry in the United States, have contributed to an increase in tobacco use outside of the United States, particularly in developing nations [62-64].

Minimum sales age—In the United States, efforts to regulate the retail availability of tobacco have almost exclusively been targeted at reducing the ability of youth to purchase. Based on a comprehensive review of the literature, Levy et al. estimated that half of youth tobacco supply comes from retail sources, suggesting that efforts to limit retail access could have a notable impact on youth supply [65]. Similar to alcohol, local efforts have demonstrated that efforts to enact and enforce underage tobacco laws can reduce the retail sales rate of tobacco

to youth [66-70]. United States investigations of the relationship between youth tobacco access and actual tobacco use have found varying effects, however, with some studies finding small or no effects on reductions of tobacco use from youth access restrictions [71, 72] and others finding significant declines in use after aggressive enforcement of underage retail access laws [73-76].

Illicit drugs—While retail sellers of illicit drugs face many of the same concerns as distributors of legitimate goods, sellers of illegal goods are concerned about police apprehension, so sales operations must be done covertly. Conversely, illegal retailers cannot depend on civil or criminal justice remedies to mediate disputes or to offer protection from violence.

Few studies have examined the relationship between efforts to change the retail availability of illicit drugs and their use or associated problems. MacCoun and Reuter looked at the effects of marijuana depenalization in the Netherlands [77]. Depenalization yielded no marijuana use changes between 1976 and 1983, but between 1984 and 1996, during which time commercial access to marijuana increased, sharp increases of marijuana use occurred. Police crackdowns as a strategy to reduce availability have had a mixed history of success. Reuter et al. found that significant drug deal arrests in Washington, DC, did not significantly interfere with the surge of drug sales [78]. More typical, however, were crackdowns in New York City in which quick buy-and-bust operations and high police visibility resulted in reductions in visible drug trafficking [79]. Drug sales generally picked up again after police resources were removed [80-82]. Studies of drug abatement actions, in which property owners are threatened with civil suits unless drug sales are terminated, have found these actions effective in achieving their immediate goal of eradicating drug activity [81-83].

Summary—When alcohol and tobacco are readily available through retail channels, consumption and associated problems increase. Conversely, research has found that when restrictions are placed on retail availability, use and associated problems decrease. Studies of drug markets, while primarily descriptive, provide support for the importance of the marketplace in making illicit drugs more or less available.

Social Availability

Social availability refers to the procurement of ATOD through “social sources,” such as friends and relatives. Substances obtained through social sources are provided with no exchange of money or goods. Studies exploring the relationship between social availability and ATOD use or related problems use primarily self-report information. Few efforts have been made to study efforts to change the social availability of substances.

Alcohol—Worldwide, it is estimated that 36% to 67% of drunk driving offenders had their last drink in some type of unlicensed premise, such as in a

home or at a party [84-87]. Underage drinking parties offer the opportunity for high-risk consumption of alcohol (i.e., binge drinking) and the initiation of alcohol use for younger adolescents [88-92].

Surveys and focus groups of persons under the legal purchase age of 21 have indicated that the majority of alcohol consumed by youth is obtained through social sources, such as parents and friends, at underage parties, and at home [92-94]. Surveys suggest that younger youth rely on social sources for alcohol more than older youth [89-92, 95]. A large percentage of college youth report, however, that they do not pay for alcohol, often because they drink at parties where someone else has supplied the alcohol [96]. Intervention research on social availability is in its infancy, and little evaluation data are available to further explore the strength of the social availability use/problems relationship.

Tobacco—Youth report that the most common sources of cigarettes are gifts, borrowing, or stealing from family members and peers [72, 97-101]. Younger, occasional, and new smokers are more likely to obtain cigarettes from social sources than older, well-established smokers [95, 97, 102]. Because 75% of smokers initiate smoking before the age of 18, access to tobacco through social sources at a young age is believed to be an important factor influencing later use and subsequent problems [103-105]. Like research on social sources of alcohol, little intervention research has been conducted to test the causal relationship between social availability of tobacco and use/problems.

Illicit drugs—Findings related to social availability and its relationship to illicit drug use and associated problems are sparse. Caulkins found a large percentage of persons who reported past-month use obtained their drugs as a gift (42% for marijuana, 35% for powder cocaine, and 24% for crack cocaine) [106]. An additional percentage of users (32% marijuana, 23% cocaine, and 19% crack) reported buying their drugs from friends rather than dealers, indicating that retail sellers may extend into informal social networks. Respondents between the ages of 18 and 25 were more likely to be approached by sellers than respondents between the ages of 12 and 17, and 26 or older [107]. As with tobacco, no intervention research has tested the relationship between social availability of illicit drugs and use/problems.

Summary—Research indicates that a significant percentage of ATOD is obtained through social sources. Limited research has indicated that the availability of ATOD through social sources is associated with specific problems, including drinking and driving and initiation of use at young ages. Intervention research is in its infancy.

Promotion

Retailers attempt to increase demand through the promotion of their products. Especially in highly concentrated markets, companies tend not to compete on

price, but rather try to increase sales with advertising and other promotional efforts [108]. This promotion attempts to increase the attractiveness of drinking, smoking, or using drugs by creating an image favorable to consumption. Advertising and promotion is intended to recruit new and retain old users and may affect attitudes and individuals' decisions regarding whether, when, and how much to consume.

Alcohol—Alcohol advertising and other pro-drinking messages are universal in many Western countries, including the United States. Alcohol images are transmitted via billboards, sponsors' logos, magazine and print messages, and television and radio programming [109]. Research has reported high recall of alcohol advertising among youth, and investigations of youth also indicate that expectancies related to the effects of alcohol and intentions to drink can be positively influenced by advertising [110-113]. Studies of youth have found that increased exposure to alcohol ads is associated with increased consumption [114, 115] and with heavy or hazardous drinking [116, 117]. At the aggregate level, studies of the effects of advertising restrictions have produced inconsistent findings regarding the relationship between alcohol promotion, per capita consumption, and drinking problems [5, 118]. Studies of partial advertising bans in Canadian provinces failed to show clear impacts, perhaps because advertising from outside the province was not restricted [119-121]. In contrast, a major time-series study of advertising bans implemented in European Community countries during the 1970s showed significant effects, including lower levels of consumption and alcohol-related problems as indicated by motor vehicle fatality rates [122-126].

Tobacco—As with alcohol, the promotion of tobacco products is widespread. Youth are routinely exposed to high levels of tobacco marketing [127], and studies have shown that cigarette advertising is effective in gaining children's attention to tobacco [128, 129] and positively associated with increased smoking initiation and overall consumption by underage smokers [130-133]. Evidence from studies that examine the relationship between overall advertising expenditures and total cigarette sales is inconclusive, but most find small or no association between advertising and sales. These results may be attributable in part to high cigarette advertising expenditures, as well as to the fact that the majority of promotional dollars are spent on activities other than advertising [108, 134-136]. Studies using cross-sectional data at the local level, which take advantage of larger variations in local advertising levels, have reported positive effects of cigarette advertising on use [108, 137-139]. Some studies of advertising restrictions have shown that comprehensive bans on advertising and promotion lead to significant decreases in consumption [28, 108, 140, 141], whereas others found that cigarette advertising bans had little or no effect on use [108, 142, 143].

Illicit drugs—Given that the use of illicit drugs is illegal, promotion of these drugs through regular advertising channels is limited, although some magazines

and Web sites do promote particular drugs, drug paraphernalia, and drug-using lifestyles (e.g., High Times). Studies of retail markets have documented the promotion of drugs through such activities as “branding” (i.e., providing some type of identifiable label) [144-148], drug giveaways, discounts to existing and potential clients [147], and word-of-mouth communication [148]. While we know of no studies that have examined the relationship between promotion and illicit drug use and associated problems, policymakers (e.g., United Nations’ International Narcotics Control Board) strongly believe illicit drug promotion is occurring and have concluded that the prevention of illicit drug use has become increasingly difficult, at least partly because of messages that promote drug use.

Summary—Higher levels of exposure to alcohol and tobacco advertising are associated with increased consumption and problems. Partial restrictions on advertising may have little impact on the promotion/use relationship, but total bans have resulted in reductions in use. Few studies of drug market promotion exist, although policymakers have concluded that promotion is related to illicit drug use.

Community Norms

Norms govern the acceptability or unacceptability of certain behaviors, including substance use. Varying across cultures, contexts, and subgroups, these community norms reflect general attitudes regarding ATOD use and societal expectations regarding the level and type of use that is considered appropriate. These norms may also be codified in public policies, laws, and regulations, which may directly affect Availability, Promotion, and/or Use (see Figure 1). Control theory provides one explanation of how social norms can influence ATOD use behavior. The theory states that ties with social institutions inhibit drug use by promoting conformity to group and social norms [149].

Alcohol—Countries have varying alcohol consumption rates and patterns not only because of differences in price and availability, but also because of differences in social norms that govern drinking behavior [150-154]. Skog observed that individuals living in environments in which drinking and/or excess drinking is not sanctioned tend toward light alcohol consumption, while individuals inhabiting “wet” environments tend toward heavier use [155, 156]. Attitudes toward public policies designed to restrict alcohol use provide supporting evidence about social norms. Results of surveys in both the United States and internationally showed increasing support over time for restrictions on alcohol access and use [157-159]. Counteradvertising has been used to try to change social norms regarding acceptable use. Research has been limited primarily to evaluations of the Federally-mandated warnings on alcoholic beverage containers, but no direct impact on problems has been reported [160-163].

Tobacco—One of the ways in which the influence of cultural values can be studied is by examining the effects of acculturation, which can discourage use if

the country to which a new group is acculturating has negative attitudes toward smoking, or encourage use, if the country has pro-smoking norms. Gajalakshmi et al. reported that tobacco consumption has been decreasing steadily among wealthier nations and increasing among middle- and low-income countries [164]. The Centers for Disease Control and Prevention (CDC) reported that Pacific Islanders who showed greater acculturation to the United States had lower smoking rates than their less acculturated counterparts [165]. Historically, gender differences in smoking rates likely reflect social norms regarding a woman's role in the United States and other countries [166, 167], suggesting that gender roles may determine social acceptability of smoking. Smoking images on TV and in movies can increase acceptability of smoking among youth and their subsequent use of tobacco products [168-170]. Surveys conducted in the United States showed increasing support over time for restrictions on tobacco access and use, indicating a temporal change in norms [171-174]. Mass media campaigns represent a way to influence community norms. Friend and Levy found that well-funded and implemented mass media campaigns targeted at the general population and implemented at the state level, in conjunction with a comprehensive tobacco control program, were associated with reduced smoking rates among both adults and youth [20]. Warning labels on cigarette packages have had little impact on tobacco use in the United States, but have had more influence in Canada and Australia, where the labels are more prominent [175-178].

Illicit drugs—Little research exploring the influence of social norms on illicit drug use was found. As expressions of community values and norms, national drug policies can provide evidence of prevailing norms. For example, the national policy in Australia emphasizes harm minimization [179], while Sweden emphasizes a more conservative drug control policy that is characterized by a reduction of treatment and prevention and a greater emphasis on stricter punishment. Mixed findings have been reported about the effects of counteradvertising on drug beliefs, perceptions, and use [180, 181].

Summary—Evidence to support the relationship between community norms and ATOD use and problems comes primarily from the observations that levels and types of use and public policies to address use vary across culture, time, and place. Researchers struggle to define and measure community norms, and little research directly addresses the relationship between norms and use.

Enforcement

Enforcement of formal ATOD policies is an important variable in any causal model. While the mere existence of regulations, laws, and administrative restrictions can influence ATOD use and associated problems, the effect size is magnified when there are consequences for violations. As the actual and/or perceived likelihood of being detected and arrested or cited for law violations increases,

so does compliance. Ross reported that *perceived* enforcement might be more important in successful outcomes than *actual* enforcement, at least initially [182]. The perception, however, may eventually need to match reality for the deterrent effect to be sustained [183, 184]. Evidence to explore the relationship between enforcement and use or associated problems comes from studies of the enforcement of a variety of specific policies.

Alcohol—Selective breath testing (SBT) and random breath test (RBT) checkpoints have been used to enforce drinking and driving laws in the United States and abroad. In a systematic review of the literature, Shults et al. found strong evidence that both SBT and RBT result in reduced fatal and nonfatal injury crashes [40]. Studies that look at efforts to enforce youth access and specific types of use policies have found that increased enforcement is related to changes in use and related problems. Strategies to limit youth access to alcohol have generally involved some combination of merchant education, community participation and mobilization, and enforcement in the form of compliance checks and penalties for violators. Consistent enforcement of MDDPA laws, combined with penalties for sales, has been found to reduce youth drinking and associated problems, including alcohol-related crashes [60, 185-187]. Wagenaar and Wolfson found that, without adequate penalties, attempts to reduce underage retail sales were likely to be ineffective and that only two of every 1,000 occurrences of underage drinking resulted in arrest [188].

Tobacco—Studies of strategies to limit youth access to tobacco provide strong evidence that increases in enforcement of policies can restrict both tobacco use and problems associated with use. Multiple studies have indicated that adding local enforcement to efforts to reduce retail sales of tobacco to underage persons increases retailer compliance with minimum legal age purchase laws [68, 70, 73, 189], while policies to limit tobacco sales to youth without enforcement have limited effects on tobacco sales to youth [67, 74, 190, 191]. Enforcement of clean air laws have been shown to reduce worksite exposure, reduce daily consumption among users, and increase cessation.

Illicit drugs—Enforcement focuses on the extent to which drug consumers/sellers or potential drug consumers/sellers can be deterred by the threat of arrest and/or harsh punishments for illicit drug offenses. Caulkins noted that “zero-tolerance” policies, or policies that impose equally severe sanctions for all levels of drug offenses, may actually stimulate drug consumption [193]. Local police crackdowns, a type of focused enforcement, entail “an abrupt increase in policy activity . . . which is intended to dramatically increase the perceived and/or actual threat of apprehension for specific types of offenses in certain places or situations” [194]. The efficacy of crackdowns has not been firmly established. The Netherlands’ formal policy of nonenforcement for violations of cannabis possession had virtually no effect on levels of marijuana use

[77]. Rydell et al. [195], Weatherburn and Lind [57], Yuan and Caulkins [196], and Wood et al. [197] found no relationship between large-scale drug seizures and use and perceived availability of drugs. Taken collectively, marginal changes in enforcement efforts have done little to change illicit drug use patterns or problems.

Summary—Studies of efforts to enforce specific alcohol and tobacco policies provide evidence that enforcement efforts can result in reductions of alcohol and tobacco consumption and associated problems over and above simple passage or existence of a law. For illicit drugs, in which strict policies prohibit buying, selling, and using most drugs, and both penalties and enforcement already exist at relatively high levels, marginal increases in enforcement efforts appear to do little to change use patterns or problems. Indeed, research suggests that increased enforcement may at times result in increased use and/or problems.

Individual-Level

In addition to the six aforementioned environmental domains that influence ATOD use and associated problems, there are individual-level factors that shape these outcomes. Major individual-level perspectives are: 1) biological; 2) social control; 3) social learning; and 4) general strain. Biological theorists argue that there is a hereditary predisposition to ATOD use. Social control theory states that ties with social institutions inhibit ATOD use by promoting conformity to group norms. Social learning theory posits that all legitimate and illegitimate behaviors are learned, and that the principles of operant conditioning dictate how individuals become inclined to ATOD use. General strain theory (GST) suggests that ATOD use is the direct result of the failure to achieve positively-valued goals, the removal of positively-valued stimuli, and the presence of noxious stimuli. As with the six domains discussed previously, we review both the associational research that has linked these theoretical perspectives to ATOD use and associated problems, and the intervention research that has attempted to reduce ATOD use and associated problems through the manipulation of these individual-level characteristics.

Alcohol—A body of research has determined that alcohol use and abuse can be attributed to both biochemical [198-200] and genetic [201-206] factors. Consistent with social control theory, single-parent families and family systems disrupted by death or divorce [207-209] are related to alcohol use among youth. Adolescents who do not have a close relationship with their parents, who do poorly in school, and who lack strong religious beliefs are also more likely to become alcohol-involved [210, 211]. Empirical tests of social learning theory have confirmed that familial alcohol-using behaviors are strong predictors of adolescent alcohol use [212-214]. While GST is relatively new, initial research has suggested a positive relationship between a youth's level of strain and subsequent alcohol use [215-217].

A large body of intervention research indicates that individual-level factors can be manipulated to reduce alcohol use and abuse. Early childhood interventions, such as teaching parenting and social skills to caregivers, have been shown to reduce alcohol use among youth [218, 219]. School programs that teach social competency and establish norms against alcohol use have reduced favorable attitudes toward alcohol use and reduced the prevalence of alcohol use among school-aged populations [220, 221]. Programs that have focused on improved academic performance and school and family bonding have reduced short-term alcohol use [222]. Social influence strategies have also been shown to have beneficial effects in the onset of alcohol use [221, 223-226].

Tobacco—A small body of research has determined that tobacco use can be attributed to genetic factors [201, 227, 228]. Consistent with social control predictions, unstable family systems are related to cigarette use among youth [207, 209]. Empirical tests of social learning theory have confirmed that ATOD salience in the household is a strong predictor of children's expectations to use tobacco and the actual use of tobacco [214, 229]. While GST is relatively new, initial research has suggested a relationship between a youth's level of strain and tobacco use [216, 217, 230].

Early childhood interventions, such as teaching parenting and social skills to caregivers, have been shown to reduce tobacco use among youth [218, 219, 231]. Reviews of social influence and health consequence strategies have found modest but significant reductions in the onset and prevalence of cigarette smoking [223, 224, 232, 233].

Illicit drugs—The significance of familial transmission of drug abuse and dependence is well established [234, 235]. Studies of twin registries [236] and the classic adoption studies of Cadoret et al [237, 238] have demonstrated the importance of genetic factors to drug-related disorders. Consistent with social control predictions, single-parent families and family systems disrupted by death or divorce are related to illicit drug use among youth [207, 209, 239]. Adolescents who do not have a close relationship with their parents, who do poorly in school, and who lack strong religious beliefs are also more likely to become drug-involved [210, 211, 214, 240, 241]. Empirical tests of social learning theory have confirmed that exposure to adults and peers who use drugs is a strong predictor of adolescent illicit drug use [214, 229, 242-245]. While GST is relatively new, initial research has suggested a relationship between a youth's level of strain and illicit drug use [215-217, 230].

Early childhood interventions, such as teaching parenting and social skills to caregivers, have been shown to reduce illicit drug use among youth [218, 246]. School programs that involve curriculum restructuring and the teaching of social competency have led to reduced drug use [247]. Programs that have focused on improved academic performance and school and family bonding have reduced

both short- [248, 249] and long-term drug use [222]. Social influence strategies have also been shown to reduce the onset of drug use [223, 224, 226].

Summary—A large body of associational evidence suggests that individual-level factors affect a person's inclination to use alcohol, tobacco, and illicit drugs. Moreover, the intervention research suggests that ATOD use can be changed directly by manipulating the individual factors that increase one's proclivity toward ATOD use.

DISCUSSION

We present an ATOD causal model that identifies Domains that are theoretically salient and empirically connected *across* alcohol, tobacco, and illicit drugs. The model identifies key domains which are important to effective prevention. In many cases, some of these Domains are more powerful than others and deserve special attention. The most salient domain is *Economic Availability*. The research evidence overwhelmingly indicates that, across the three substance categories, consumption declines as price increases. There is also strong evidence for the inclusion of *Retail Availability* in the model. When restrictions are placed on the retail availability of alcohol and tobacco, consumption and associated problems decrease. While there is little evidence to demonstrate that efforts to reduce the retail availability of illicit drugs would have a similar effect, descriptive studies of the illicit drug market suggest that a similar relationship exists. At worst, attempts to reduce the retail availability of illicit drugs would result in displacement (i.e., drug markets may shift in location or structure to accommodate new retail restrictions).

Support for the inclusion of *Social Availability* comes primarily from surveys that have shown that a significant proportion of alcohol, tobacco, and illicit drugs are obtained through social sources. Limited research indicates that the availability of ATOD through social sources is associated with specific problems.

Research also provides strong support for the inclusion of *Promotion* in the model. Higher levels of exposure to alcohol and tobacco advertising are associated with increased consumption and problems. It appears, however, that partial restrictions on advertising have little impact on the promotion/use relationship. Instead, total bans are needed to reduce use. Few studies of illicit drug market promotion exist, although it is reasonable to hypothesize that illicit drug promotion is related to use.

The evidence to support the inclusion of *Community Norms* in the model is less conclusive. In general, evidence to support the relationship between community norms and ATOD use and problems comes from the observations that levels and types of use and public policies to address use vary across culture,

time, and place. Studies struggle to define and measure community norms, and little research directly addresses the relationship between norms and use.

Studies of efforts to enforce specific alcohol and tobacco policies provide strong evidence that enforcement efforts can result in increased reductions of alcohol and tobacco consumption and associated problems over and above simple passage or existence of a law, providing support for the inclusion of *Enforcement* in the model. For illicit drugs, in which strict policies prohibit buying, selling and using most drugs, and both penalties and enforcement already exist at relatively high levels, marginal increases in enforcement efforts appear to do little to change use patterns or problems.

A large body of evidence suggests that *Individual-Level* factors affect a person's inclination to use alcohol, tobacco, or illicit drugs. Moreover, intervention research finds that ATOD use can be changed when specific individuals, or persons nested within certain environments (e.g., schools), are directly targeted. These successes are achieved by manipulating the individual-level factors that increase one's proclivity toward ATOD use. The major stumbling block to individual-level prevention efforts, however, is the inability to affect long-term change at the population level. While it is theoretically possible (though not practically feasible) to intervene at the individual level with every student in the United States, such interventions would necessarily need to be repeated as frequently as members of the population change. That is, when targeting individuals, there will always be new people in need of intervention. The environmental domains discussed in the current essay address population turnover by focusing on the environment in which individuals live, rather than the individuals themselves.

Complex systems cannot be completely understood by breaking them down into individual components. Undoubtedly, there are complex interactions among all of the domains in our model. To date, scientific research provides limited support and clarity to the complex system which results in substance use and its problems. Even this depth of understanding, however, can significantly assist prevention practitioners and policymakers design and implement strategies to effectively intervene to change patterns of ATOD use and related problems.

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