

# **Prevention of Methamphetamine Use and Associated Harm: *Logic Model Documentation***

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## **I. Conceptual Definition**

Methamphetamine-associated harm refers to the myriad negative personal and social consequences related to the recreational (i.e., nontherapeutic) use of prescription and illicit methamphetamine.

**Justification:** Methamphetamine, a derivative of amphetamine, is a powerful stimulant that affects the central nervous system. Medical consequences of methamphetamine use include cardiovascular problems, such as rapid heart rate, irregular heartbeat, increased blood pressure, and stroke-producing damage to small blood vessels in the brain. Hyperthermia and convulsions can occur when a user overdoses and, if not treated immediately, can result in death. Among users who inject the drug and share needles, methamphetamine abuse can increase users' risks of contracting HIV/AIDS and hepatitis B and C. Methamphetamine use during pregnancy can cause prenatal complications, such as increased rates of premature delivery, congenital deformities, and altered neonatal behavior patterns.

Chronic abuse of methamphetamine can lead to psychotic behavior including paranoia, hallucinations, and out-of-control rages that can result in violent episodes. Other consequences of long-term use are inflammation of the heart lining, insomnia, anxiety, weight loss, and addiction. Social and occupational connections progressively deteriorate for chronic methamphetamine users. Prolonged exposure to relatively low levels of methamphetamine can cause damage to as much as 50% of the dopamine-producing cells in the brain and even more extensive damage to serotonin-containing nerve cells. Acute lead poisoning is another potential risk for methamphetamine abusers because of a common method of production that uses lead acetate as a reagent.

Harm associated with methamphetamine use and abuse/dependence extends beyond the individual user to the broader community. These negative social consequences of methamphetamine use include the transmission of sexually transmitted diseases (Boddinger, 2005; Choi et al., 2005; (Hirshfield, Remien, Humberstone, Walavalkar, & Chiasson, 2004), other health consequences ((Hohman, Oliver, & Wright, 2004); Cohen et al., 2003; (Derauf, Katz, Frank, Grandinetti, & Easa, 2003), crime (Hohman et al., 2004); Cohen et al., 2003; (Derauf et al., 2003), environmental contamination from toxic waste at methamphetamine production sites, and public nuisances associated with injection drug use. In a recent survey of the National Association of Counties (National Association of Counties, 2006), methamphetamine abuse was cited by more law enforcement officials as their county's primary drug problem—more than cocaine, marijuana and heroin combined.

## **Measurement of the Problem**

Methamphetamine-related problems can be measured through self-report survey data. Currently, the best available data are obtained through the Drug Abuse Warning Network (DAWN). During 1995, hospitals participating in DAWN reported 15,933 mentions of methamphetamine. By 1999, the number of methamphetamine emergency department (ED) mentions decreased to 10,447. This number increased to 17,696 in 2002. In 2001, DAWN's mortality data for methamphetamine mentions to medical examiners remained concentrated in the Midwest and West regions of the United States. The metropolitan areas reporting the most methamphetamine-involved deaths were Phoenix (122), San Diego (94), and Las Vegas (53). The East Coast area that reported the highest number of methamphetamine deaths was Long Island (49). Out of 42 metropolitan areas studied, 15 areas reported fewer than five methamphetamine deaths.

Recommended Indicator/Measure 1: Annual number of methamphetamine-related emergency department (ED) visits

*Definition:* Visits to the ED related to any recent drug use in which methamphetamine was one of the drugs implicated in the visit and mentioned (recorded) in the patient's medical record

*Data Source:* Drug Abuse Warning Network (DAWN)—ED Component, Substance Abuse and Mental Health Services Administration (SAMHSA), U.S. Department of Health and Human Services (DHHS)

*Frequency:* Annual

*Geographic Levels:* The nation as a whole (through national-level estimates) and the individual metropolitan areas oversampled (through counts of drug-related morbidity). Prior to 2003, the DAWN hospital sample was drawn from the coterminous US (i.e., excluding Alaska and Hawaii). Since the redesign of DAWN that began in 2003, hospitals in Alaska and Hawaii are represented in the sample, providing national estimates.

*Demographic Categories:* Age, gender, ethnicity

*Strengths:* DAWN is an ongoing, national public health surveillance system that collects and reports information on adverse health consequences associated with drug use. As such, it is an indicator of the nation's drug problems and an important method for tracking local area drug trends. DAWN collects data on the demographic characteristics of cases and the specific drugs involved in each drug-related ED visit. No other data system contains the level of detail on specific drugs as DAWN.

Beginning in 2003, numerous changes were made to the sampling methodology and the data collection and reporting activities (Substance Abuse and Mental Health Services Administration, 2002), (Substance Abuse and Mental Health Services Administration, 2005a). These included: 1) case finding by a retrospective review of ED medical records for every patient treated in a participating ED to ensure that all relevant cases are identified and included in the database; 2)

conversion from paper to electronic reporting, providing a technological means for validating DAWN data as they are entered and ensuring more timely data collection, analysis, and dissemination of findings; 3) inclusion of hospitals in Alaska and Hawaii to provide data from all states for the national estimates; 4) confirmation of drugs by laboratory testing; 5) systematic training and certification of DAWN reporters; and 6) revised case definitions.

*Limitations:* DAWN does not estimate the prevalence of illicit drug, but rather tracks the consequences of recent use (of illicit and licit drugs regardless of intent to abuse) that result in an ED visit. Thus, while DAWN captures episodes (i.e., cases where problems resulting from drug use require urgent medical attention), the data cannot be used to provide estimates of the prevalence of drug use in the population. Although the new sampling methodology updated the boundaries of the many of the metropolitan areas included in DAWN based on the 2000 census, many areas of the country are only represented in the national sample and thus cannot get local trend data.

Recommended Indicator/Measure 2: Annual number of methamphetamine-related deaths from medical examiner and coroner jurisdictions

*Definition:* Number of methamphetamine-involved deaths (both drug-induced and drug-related), including deaths causally or indirectly related to prescription methamphetamine as well as illicit methamphetamine

*Data Source:* Drug Abuse Warning Network (DAWN)—Medical Examiner Component, Substance Abuse and Mental Health Services Administration (SAMHSA), U.S. Department of Health and Human Services (DHHS)

*Frequency:* Annual

*Geographic Levels:* Metropolitan areas and the Medical Examiner/Coroner (ME/C) jurisdictions within the metropolitan statistical areas; No national estimates available

*Demographic Categories:* Age, gender, ethnicity

*Strengths:* The DAWN-ME data are a unique source of information on drug-related mortality. DAWN is the only large-scale surveillance system that collects data directly from MEs and coroners (ME/Cs). Because death certificates are not reliably updated with information obtained by ME/Cs after the completion of a full death investigation (which usually includes toxicology test results), DAWN-ME provides a more complete accounting of drug-involved mortality. Additionally, DAWN-ME is unique in the level of drug detail it collects and reports. DAWN-ME collects data on all illicit or abused substances and related metabolites detected in the decedent, whereas other data sources, such as national vital statistics data, list only a few drugs or drug categories and are limited by the short list of specific drugs available when using ICD-9 or ICD-10 codes. DAWN-ME is the only system of its type to provide data for specific metropolitan areas, and it can provide data at the jurisdiction level. As such it provides ME/Cs with drug-related deaths in “their own backyard”—information that is important for effective

surveillance of local drug trends. DAWN-ME can provide ME/Cs with timely data on drug trends in their jurisdictions and surrounding areas that can inform decisions about new drugs of abuse to test for in death investigations rather than ME/Cs relying solely on standard toxicology panels unlikely to pick up new drugs.

*Limitations:* DAWN-ME does not provide national estimates, which are available from other existing systems. There are substantial differences between states (and among jurisdictions within states) in the type of cases accepted for review, the review processes used (e.g., toxicology test protocols), and the qualifications/training of staff involved in collecting DAWN-ME data. Thus, lack of consistency in the source of data across the more than 2,000 ME/C jurisdictions limits the ability to make comparisons across jurisdictions.

Recommended Indicator/Measure 3: Annual number of primary methamphetamine treatment admissions

*Definition:* Number of admissions for substance abuse treatment in which methamphetamine was the primary substance of abuse

*Data Source:* Treatment Episode Data Set (TEDS), Substance Abuse and Mental Health Services Administration (SAMHSA), U.S. Department of Health and Human Services (DHHS)

*Frequency:* Annual

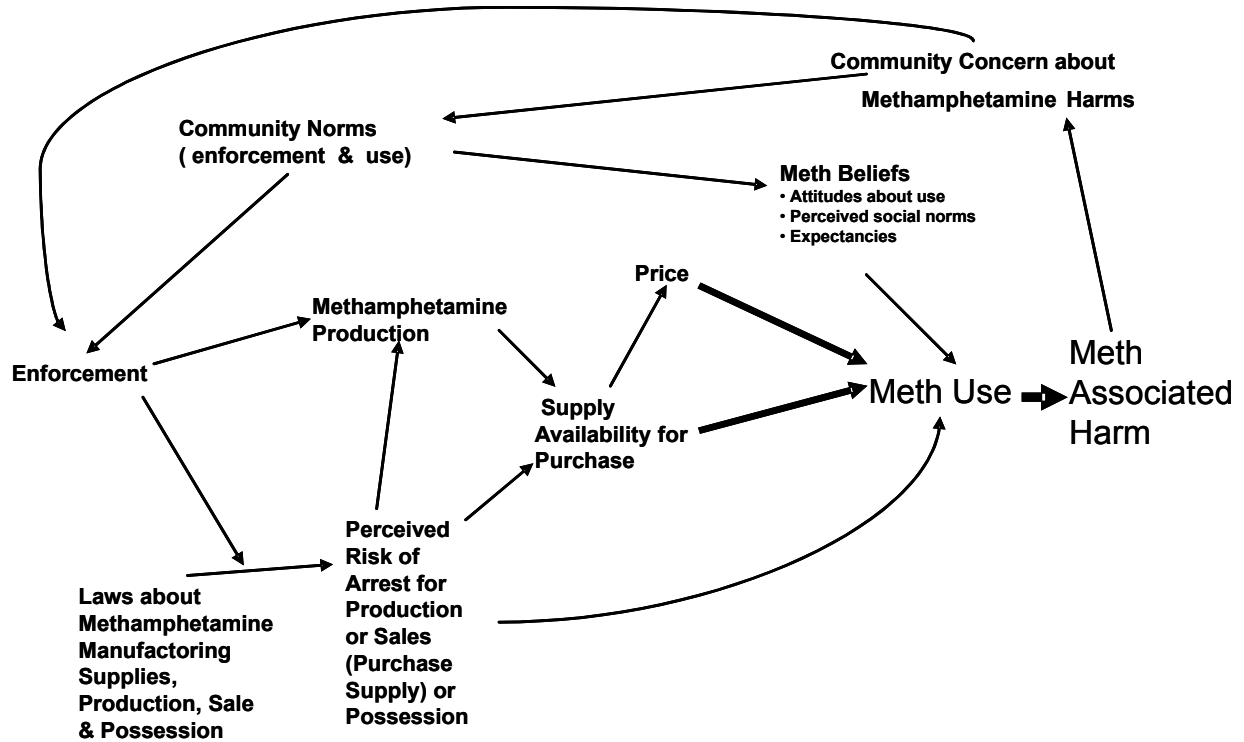
*Geographic Levels:* National, state

*Demographic Categories:* Age, gender, race, ethnicity, education level

*Strengths:* TEDS is an annual compilation of data on the demographic characteristics and substance abuse problems of persons admitted for substance abuse treatment. TEDS provides important data for tracking trends in substance use across demographic groups and across states.

*Limitations:* The data for TEDS come primarily from facilities that receive some public funding. Therefore, it does not include all admissions to substance abuse treatment. Like DAWN-ED data, TEDS records represent episodes (i.e., treatment admissions) rather than individuals and thus cannot provide prevalence data. Although listed separately in the TEDS minimum data set, some states do not distinguish methamphetamines from other amphetamines. Therefore, for reporting purposes, most TEDS publications report findings for methamphetamine/amphetamine treatment admissions, of which about 80-90% relate to methamphetamine as the drug of abuse.

## II. Causal Model



### **III. Documentation of Intermediate Variables, Relationships and Prevention Strategies**

This section documents each of the elements (problems, intermediate variables, relationships, and strategies) for the causal model presented in Section II. For each intermediate variable, the following subsections headings (in bold) will be used:

**Conceptual Definition:** This is the definition of the intermediate variable and in some cases may provide a rationale for why this intermediate variable is included in the model.

**Measurement:** This is the method, technique, tool, or approach used to measure the variable and to develop valid and reliable indicators. Data sources may be surveys, official data, or other sources.

**Relationship of the Intermediate Variable to the Problem:** This subsection is a summary of the research evidence of the relationship of the intermediate variable to methamphetamine use and the problems associated with its use. Emphasis is given to published research findings in peer-reviewed, scientific journals. In some cases, no direct empirical may exist between the intermediate variable(s) and methamphetamine use/problems. In that situation, the relationship posited may be a reasoned argument based on other research evidence that may be generalized to this case or situation.

**Relationship of the Intermediate Variable to Other Variables:** This subsection is a summary of the research evidence of the relationship of one intermediate variable to any other variable as shown in the model. In this summary, each relationship discussed will focus on the causal, moderating, or mediating relationship to another variable. For example, “Price → Methamphetamine Use.” Any reciprocal relationship will be discussed in the documentation of the *independent or influencing variable*. For example, the influence of price and methamphetamine use will be discussed under Price. In the Section III documentation, each of the relationships presented will have a unique heading (in italics), for example: *Price to Methamphetamine Use*.

In some cases, there may be no direct empirical evidence of the relationship of the intermediate variable to another variable as shown in the causal model. In such situations, the relationship posited may be a reasoned argument based on other research evidence that may be generalized to this case or situation.

**Strategies:** This subsection will present the research evidence concerning strategies, interventions, policies, and programs which have been shown to affect this intermediate variable. Evidence that purposeful changes in the intermediate variable can affect the problem and evidence of effects on other intermediate variables will also be summarized. Limitations of the research evidence or a lack of any research evidence will be so noted. In many cases, the research evidence that demonstrates a causal or mediating influence of one intermediate variable to the methamphetamine problem or to other variables in the causal will have already been noted in previous subsections.

## **Methamphetamine Use**

**Conceptual Definition:** Methamphetamine use is the recreational use (i.e., excluding medicinal/therapeutic purposes) of both prescription and illicit methamphetamine in any form.

Methamphetamine can be smoked, snorted, ingested orally, and injected. It can be identified by color, ranging from white to yellow to darker colors such as red and brown. Methamphetamine comes in a powder form that resembles granulated crystals and in a rock form known as “ice,” the smokeable version of methamphetamine that came into use during the 1980s.

Methamphetamine use increases energy and alertness and decreases appetite. An intense rush is felt almost instantaneously when a user smokes or injects methamphetamine. Snorting methamphetamine affects the user in approximately five minutes, whereas oral ingestion takes about 20 minutes to take effect. The intense rush felt from methamphetamine results from the release of high levels of dopamine into the section of the brain that controls the feeling of pleasure.

**Measurement:** Methamphetamine prevalence data come from the major drug use surveillance systems in the United States: National Survey on Drug Use and Health (NSDUH), Monitoring the Future (MTF), the Youth Risk Behavior Surveillance System (YRBSS), the Arrestee Drug Abuse Monitoring Program (ADAM) (now discontinued), and the Community Epidemiology Work Group (CEWG). Within each of these surveillance systems, there are questions about lifetime, past year, and past 30 day use of methamphetamine.

The NSDUH is the primary source of data on the use of illegal drugs in the United States. Conducted by the Federal Government since 1971, the NSDUH is administered to a representative sample of the population at their places of residence. Methamphetamine use, as recorded by the NSDUH, includes both prescription preparations (i.e., Desoxyn® and Methedrine) as well as non-prescription/illicit methamphetamine. In 2004, an estimated 1.4 million persons aged 12 or older (0.6% of the population) had used methamphetamine in the past year, and 600,000 persons (0.2% of the population) had used methamphetamine in the past month (Substance Abuse and Mental Health Services Administration, 2005b). Although the number of past year and past month methamphetamine users did not change significantly between 2002 and 2004, the number of past month methamphetamine users who met criteria for abuse or dependence on one or more illicit drugs in the past year increased from 164,000 (27.5% of past month methamphetamine users) in 2002 to 346,000 (59.3%) in 2004 (Substance Abuse and Mental Health Services Administration, 2005b), (Substance Abuse and Mental Health Services Administration, 2004), (Substance Abuse and Mental Health Services Administration, 2003).

The MTF study, funded by the National Institute on Drug Abuse (NIDA), began in 1975 as a way to study the drug-using beliefs, attitudes, and behaviors of high school students across the United States. Today, the program surveys approximately 50,000 grade school and high school students annually. Each data collection takes place in approximately 130 public and private high schools, thus providing an accurate cross-section of high school students throughout the

United States. Past-year methamphetamine prevalence rates for 8<sup>th</sup>, 10<sup>th</sup>, and 12<sup>th</sup> grade students in 2004 were 1.5%, 3.0%, and 3.4%, respectively, down from 3.2%, 4.6%, and 4.7% in 1999 (Johnston, O'Malley, Bachman, & Schulenberg, 2005).

According to the YRBSS, 7.6% of high school students reported lifetime methamphetamine use in 2003, down from 9.1% in 1999 and 9.8% in 1999 (Centers for Disease Control and Prevention, 2004). The prevalence of lifetime methamphetamine use was higher among white (8.1%) and Hispanic (8.3%) than black (3.1%) students, higher among white female (7.8%) and Hispanic female (8.1%) than black female (1.7%) students, and higher among white male (8.4%) and Hispanic male (8.5%) than black male (4.6%) students (Centers for Disease Control and Prevention, 2004).

The ADAM Program was established by the National Institute of Justice (NIJ) in 1987. The six primary goals of ADAM are: identifying levels of drug use among arrestees; tracking changing drug-use patterns; determining what drugs are being used in specific jurisdictions; alerting local officials to trends in drug use and the availability of new drugs; providing data to help understand the drug-crime connection; and serving as a research platform for a variety of drug-related initiatives. Self-report and objective (urinalysis) data were collected in 42 jurisdictions across the United States before the Program was discontinued at the end of 2003. Yacoubian (Yacoubian, 2005) reported methamphetamine-positive rates for all ADAM sites between 1991 and 2001. Methamphetamine use appears to be more heavily embedded in the Western part of the United States. Those ADAM sites with methamphetamine-positive rates of 30% or higher in 2001 were Honolulu (37%), San Jose (35%), San Diego (33%), and Sacramento (30%). In contrast, the major Eastern jurisdictions (New York City, Philadelphia, and Washington, DC) each had methamphetamine-positive rates of less than 1% in 2001.

Consistent with the ADAM data, the CEWG reported that, in 2002, methamphetamine indicators remained highest in West Coast areas and parts of the Southwest, as well as Hawaii. Methamphetamine abuse is spreading in areas such as Atlanta, Chicago, Detroit, St. Louis, and Texas. Relatively low indicators were found in East Coast and Mid-Atlantic CEWG areas, although abuse seems to be increasing.

Research on socio-demographic characteristics indicates that:

- Methamphetamine users tend to be white males between the ages of 18 and 35 ((Yacoubian, 2005); (Rodriguez, Katz, Webb, & Schaefer, 2005); (Yacoubian & Peters, 2004).
- While female use has increased, males are still more likely to use the drug (Oetting et al., 2000).
- Methamphetamine users are more likely to live in private housing (Rodriguez et al., 2005); (Herz, 2000); (Pennell, Ellett, Rienick, & Grimes, 1999)
- Increased use has been reported among Native Americans and Hispanics as a coping mechanism for economic impoverishment (Oetting et al., 2000).

- Methamphetamine use is also more common among individuals in blue-collar occupations (truck driving, construction, and factory work) (Jenkins, 1994); (Miller, 1991).
- Methamphetamine users are also more likely than non-methamphetamine users to have more sex partners, to trade sex for money and drugs, and to be at higher risk for HIV transmission (Molitor et al., 1999).

**Relationship of the Intermediate Variable to the Problem:** Use of methamphetamine is associated with a wide variety of harms. With respect to health problems, meth use is implicated in conditions affecting users (e.g., cardiovascular problems, HIV/AIDS, hepatitis, lead poisoning and overdose) as well as health issues involving others (e.g., prenatal complications, transmission of sexually transmitted diseases).

As with other illicit substances such as cocaine and heroin, use of methamphetamine has also been implicated as a factor in criminal activity. Findings from the ADAM Program suggest that methamphetamine use has increased among arrestees during the past decade. In Omaha, for example, the methamphetamine-positive rate increased from 1% in 1991 to 15% in 2001. In Phoenix and San Jose, methamphetamine-positive rates increased more than fivefold between 1991 and 2001— from 5% to 27% and from 6% to 35%, respectively. Similarly, TEDS data indicate that between 1993 and 2003 the proportion of primary methamphetamine/amphetamine admissions referred to treatment by the criminal justice system increased from 36% to 51% (Substance Abuse and Mental Health Services Administration, 2006). The National Association of Counties (National Association of Counties, 2006) reported that meth-related arrests continue to represent a high proportion of crimes that require incarceration, with 48% of counties reporting that up to one in five inmates are incarcerated because of methamphetamine-related crimes, and 17% of counties reporting that one in two inmates are incarcerated because of meth-related crimes. Additionally, the report found that crimes related to methamphetamine continue to grow. Forty-eight percent of law enforcement officials reported that domestic violence had increased during the past year because of the presence of methamphetamine in their counties; similar percentages for simple assault, robbery or burglary, and identity theft were 41%, 55%, and 31%, respectively.

**Relationship of the Intermediate Variable to Other Variables:** *None specified in model*

### **Strategies:**

Efforts to reduce the use of illicit drugs, including methamphetamine, fall into three broad categories: 1) *demand reduction* efforts that include education and treatment programs designed to curb consumption among users or potential users; 2) *supply reduction* efforts that seek to increase prices by reducing the quantity of drugs available for sale in retail drug markets; and 3) strategies that seek to *drive a wedge between supply and demand*. This last category includes initiatives—often undertaken by law enforcement agencies through the arrest of dealers and disruption of local retail drug markets—aimed at making it more difficult for buyers and sellers to transact business, thereby increasing their costs.

The causal model presented in Section II is comprised of the most important intermediate variables targeted by each of these three broad categories of prevention efforts. For example, demand reduction efforts seek to change characteristics of individuals to decrease the likelihood that they will use drugs. Among the many individual-level characteristics that are targeted by education and treatment programs are drug-related beliefs, social norms, and expectancies. Methamphetamine beliefs refer to individuals' assessments of how acceptable it is to use meth. Social norms are individuals' perceptions regarding the prevalence and level of meth use by others and perceived approval by important others for meth use. Expectancies are beliefs about the positive and negative personal consequences of meth use. Similarly, directly to the left of meth use are three intermediate variables—price, supply, and meth production (which directly affects the amount available for retail purchase)—which are the targets of supply reduction efforts. Finally, enforcement of laws regarding the production, sale and use/possession of meth—driven in part by community concerns about meth harms and community norms—not only serve to reduce the supply of drugs (often temporarily), but function to drive a wedge between drug sellers and drug users. Thus, all of the strategies discussed in the context of the succeeding intermediate variables may be considered strategies that are designed to affect meth use.

## **Price**

**Conceptual Definition:** Price is the cost to a user of purchasing a specific amount or supply of methamphetamine.

**Measurement:** Price is measured in terms of the cost per specific quantity of methamphetamine.

**Relationship of the Intermediate Variable to the Problem:** According to the Drug Enforcement Administration (DEA), during 2001, the price of methamphetamine ranged nationally from \$3,500 to \$23,000 per pound, \$350 to \$2,200 per ounce, and \$20 to \$300 per gram. The average purity of methamphetamine decreased from 71.9% in 1994 to 40.1% in 2001. While there is no literature that specifically addresses the relationship between methamphetamine price and its subsequent use and associated problems, the modest marijuana, cocaine, and opiate literatures (De Simone & Farrelly, 2001); (Pacula & Chaloupka, 2001); (Caulkins, 1995); (Hyatt & Rhodes, 1995) suggest that higher methamphetamine prices may directly lead to reduced methamphetamine use and associated problems.

There is also a small literature that illustrates a cross-drug relationship with price. That is, as the price of one substance increased, users substituted it for another substance (Chaloupka & Laixuthai, 1997); (Di Nardo & Lemieux, 1992). It may be, therefore, that as the price of one illicit stimulant increases (e.g., cocaine), methamphetamine prices will decrease and use and associated problems will increase.

### **Relationship of the Intermediate Variable to Other Variables:**

#### *Price to Methamphetamine Use*

Like all consumer goods, the demand for methamphetamine is price-sensitive. As methamphetamine becomes more expensive, consumption decreases. When it becomes less expensive, consumption increases. Economists have developed the construct “price elasticity” to provide a metric of consumer responsiveness to changes in price. It is measured as the percent change in per capita quantity demanded divided by the percent change in price. Econometric studies on alcohol, tobacco, and other illegal drugs have consistently provided evidence of a negative association between price and consumption.

Intervention studies have established that higher prices are associated with lower ATOD use. Studies documenting price findings for illicit drugs have used STRIDE data. These studies have found that an increase in price yields decreased use of marijuana (De Simone & Farrelly, 2001); (Pacula & Chaloupka, 2001), cocaine (Caulkins, 1995), and heroin (Saffer & Chaloupka, 1999).

## **Strategies:**

### *Increased Enforcement of Laws Regarding Meth Production, Distribution and Sale*

Because methamphetamine is an illicit drug and not subject to taxation, the government cannot regulate its retail price. Instead, authorities try to influence meth and other drug prices through strategies such as enforcing laws against producers, distributors and sellers. The underlying assumptions are that increased enforcement will raise costs to drug suppliers and dealers and that these additional costs will lead them to reduce the quantity of drugs offered for sale in retail markets and thereby drive up prices.

Despite massive increases in drug enforcement during the past two decades in the United States, prices for cocaine and heroin have fallen substantially without an evident decrease in demand (Caulkins, Reuter, & Taylor, 2006). In fact, while enforcement became much tougher—with the risk of being imprisoned as the result of being a regular dealer probably having quintupled—prices fell by about 50% (Reuter, 2001). As pointed out in the following discussion on supply, enforcement is only one of numerous cost components of retail drug prices. Therefore, if other cost components fall more than costs related to enforcement increase, overall drug prices can decline despite more vigorous enforcement.

The fact that policy approaches, specifically enforcement, have not always yielded expected results may also be explained by the nonstandard characteristics of illicit drug markets. Under conventional economic models, actions such as destroying labs, disrupting distribution networks, and arresting dealers should shift the supply curve upward and lead to higher prices and a reduced quantity consumed. As several researchers have noted (Caulkins & Reuter, 2006); (Caulkins et al., 2006); (Reuter, 2001), however, retail drug markets are influenced by factors such as addiction, product illegality, and the role of violence. Due to their failure to account for the oddities of drug markets, policy approaches based on standard competitive models, such as enforcement-only strategies aimed at suppliers and dealers, *can* at times produce perverse and unexpected outcomes on price and quantity. Scenarios described by Caulkins, Reuter and Taylor (Caulkins et al., 2006) that may help account for these counterproductive effects are discussed in the paragraphs below. Although these scenarios may not always reflect the characteristics of drug markets, they provide insights into why enforcement actions in some cases yield unexpected and undesirable effects.

When a dealer is removed from the market, lower ranking dealers in the drug selling hierarchy move into the vacated turf, with new dealers entering the market at the lower end. The net effect may be that price and quantity sold remain constant, despite the successful elimination of a given dealer. It should be noted that many retail dealers are themselves heavy users. Therefore, putting dealers in prison may have two effects: a supply-side effect as well as a demand-side effect, the latter of which may be substantial (Reuter, 2001).

Additionally, the use of violence to maintain one's turf and intimidate other dealers is an important issue as it imposes additional costs on drug selling to all but the most violent of dealers

(Caulkins et al., 2006). When one of the most violent dealers is removed from the market, the costs of operation for all other less violent dealers decrease. As the marginal cost of entry into the market goes down, there may be an increase in the number of dealers which leads to lower prices and increases in both the amount supplied and amount consumed. In this case, the effect of enforcement against the most violent of dealers may be the opposite of that intended—instead of curtailing drug markets it may in fact open them up, with attendant decreases in price.

In addition to targeting drug dealers, another enforcement strategy is to target enforcement at known drug selling locations (e.g., drug sweeps), increasing the probability of arrest for dealers operating at these sites, and thus increasing the cost of doing business (Caulkins et al., 2006). As proposed by Caulkins, Reuter and Taylor (Caulkins et al., 2006), when enforcement is targeted against marginal sites (i.e., least advantageous sites where costs of operating are already relatively high), then the increased costs are likely to have the desired effect of reducing the quantity of drugs supplied and raising prices. Alternatively, if costs increase at more lucrative sites, there is likely to be no effect on the equilibrium price and consumption of the drug.

Finally, another way to try to increase dealers' costs and thereby reduce drug selling is by increasing the penalties associated with arrest and conviction for drug dealing. As Caulkins, Reuter and Taylor (Caulkins et al., 2006) argue, although such efforts increase the costs of operation for all drug dealers, costs are greatest for marginal dealers (i.e., those dealers with the least favorable locations and who therefore face the greatest likelihood of apprehension). When costs for marginal dealers increase, the supply curve shifts up, prices rise and the quantity consumed decreases. As with enforcement targeted at marginal sites, however, the relatively high costs to marginal dealers may result in benefits to the infra-marginal dealers (i.e., those dealers who have secured favorable market position by virtue of their proclivity and ability to use violence effectively). Therefore, a potential by-product of these strategies that confer benefits to infra-marginal dealers is to increase the return to violence in illegal drug markets (Caulkins et al., 2006).

## **Summary**

As the discussion here under price and in the following section on supply indicates, predicting the effects of drug enforcement on prices is difficult. Under various circumstances, enforcement can be associated with no effect on drug prices, increased drug prices, or even decreased drug prices. As noted earlier, the outcome depends, in part, on where along the drug hierarchy enforcement actions are targeted and how price increases are transmitted down through the levels of the hierarchy. Even when enforcement actions are confined to lower levels of the hierarchy (i.e., local retail markets), outcomes may differ depending on structural characteristics of markets and whether marginal dealers and drug selling locations are targeted or whether infra-marginal dealers are removed from the market. Further complicating the issue is the fact that, as with many other products, overall drug prices are driven by many factors. Thus, even if enforcement-related costs could be reliably affected, the desired effect on overall price may not be obtained if costs associated with other costs components (e.g., importation and labor) move in the opposite direction.

With these caveats in mind, the following appears to describe what is known to date about how policy generally affects drug prices (Caulkins & Reuter, 1998). Prohibition plus some modest but nontrivial level of enforcement can drive up drug prices beyond what they would be if drugs were legal. Enforcement activities aimed at local dealers and retail markets can disrupt operations and create short-term scarcity that leads to price increases and associated benefits. Suppliers and dealers are adept at changing their tactics in response to market disruptions such that the long-run or equilibrium effects of increments in enforcement are more modest.

## Supply/Physical Availability

**Conceptual Definition:** Supply or physical availability refers to the level of methamphetamine available for purchase. Like all products, the physical availability of methamphetamine is critical to its use. All 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 their sale. Likewise, the potential for profit encourages suppliers to stimulate demand such that demand and supply are inexorably intertwined (i.e., that form a dynamic interaction), as illustrated by:

Supply ←-----→ Demand

While the literature suggests that methamphetamine sales are accomplished more through social networks than are cocaine or heroin sales, there is nothing to suggest methamphetamine transactions are anything but cash-based. Methamphetamine sales tend to take place indoors (Rodriguez et al., 2005); (Eck, 1995). Methamphetamine dealers are more likely than cocaine and heroin dealers to sell out of single family homes and to sell out of areas with fewer security measures (Rodriguez et al., 2005); (Eck, 1995).

**Measurement:** Data on supply availability come primarily from local, state, and Federal drug seizure surveillance systems. At the Federal level, STRIDE, administered by the DEA, consists of six subsystems providing information on drug intelligence, statistics on markings found on pills and capsules, drug inventory, tracking, statistical information on drugs removed from the market place, utilization of laboratory manpower and information on subsystems analyzed outside of the DEA laboratory system where DEA participated in the seizure(s). In addition, the Office of National Drug Control Policy's (ONDCP) *Pulse Check* is a source for information on drug abuse and drug markets, including information on chronic drug users, emerging drugs, new routes of administration, varying use patterns, changing demand for treatment, drug-related criminal activity, drug markets, and shifts in supply and distribution patterns.

When asked in the spring of 2002 how methamphetamine availability had changed compared to fall 2001, the majority (25 of 40) of law enforcement and epidemiologic/ethnographic sources in 17 of the 20 *Pulse Check* sites reported it had remained stable (Office of National Drug Control Policy, 2002). In contrast, the remaining 15 sources in 12 of the 20 sites believed availability had increased. There were no reported decreases in availability.

The widespread availability of methamphetamine is illustrated by increasing numbers of methamphetamine seizures, arrests, indictments, and sentences. According to the National Drug Intelligence Center (NDIC), methamphetamine is widely available throughout the Pacific, Southwest, and West Central regions and is increasingly available in the Great Lakes and Southeast.

The Federal-wide Drug Seizure System (FDSS) consolidates information about drug seizures made within the jurisdiction of the United States by DEA, the FBI, and U.S. Customs and Border

Protection, as well as maritime seizures made by the U.S. Coast Guard. According to the FDSS, 2,807 kilograms of methamphetamine were seized in 2001 by U.S. Federal law enforcement authorities, down from 3,373 kilograms in 2000. Federal authorities also seized 301,697 Southeast Asian methamphetamine tablets in the U.S. Postal Service facilities in Oakland, Los Angeles, and Honolulu in 2000, representing a 656% increase from the 1999 seizures of 39,917 tablets.

According to the El Paso Intelligence Center's National Clandestine Laboratory Seizure System, 8,290 methamphetamine labs were seized in 2001. In 2001, there were 303 “superlabs” with the capacity to produce 10 or more pounds of methamphetamine in one production cycle seized in the United States.

**Relationship of the Intermediate Variable to the Problem:** We posit a direct, positive relationship between supply/physical availability and methamphetamine use and related harms. That is, as supply decreases, subsequent methamphetamine use and associated negative consequences should also decrease. Limited research has examined the relationship between the physical availability of illicit drugs and use or problems. Depenalization of marijuana in the Netherlands yielded no changes between 1976 and 1983, but between 1984 and 1996, during which time commercial access to marijuana increased, sharp increases of marijuana use occurred (MacCoun & Reuter, 2001). Some work by Freisthler and colleagues on spatial relations between availability and use, however, suggest that the relationship between illicit drug sales/distribution and consumption (and thus harms) may be more complex. For both youth and adults, Freisthler, Gruenewald, Johnson, Treno, and LaScala (2005) found that although self-reported drug use was positively related to drug sales in surrounding geographic areas, associations between use and sales in residents’ immediate communities was negative for adults and non-existent among youth. These findings indicate that access to illegal drugs takes place across neighboring regions and that often residents living in areas with drug markets are not the consumers of drugs. Although residing in a community with drug markets may not be positively associated with use, such residents may still suffer harms due to the presence of drug markets such as drive-by shootings, increased crime, environmental contamination and other public nuisances associated the drug trade.

**Relationship of the Intermediate Variable to Other Variables:**

*Supply/Physical Availability to Price*

According to standard economic theory, when the supply of legally sold goods decreases (i.e., the supply curve shifts up and to the left), price rises and the quantity purchased decreases. Illegal drugs, however, are sold through informal markets rather than standard retail markets. Thus, while economic theory would predict that efforts to reduce supply should yield higher drug prices, factors associated with illicit markets complicate the relationship between supply and price.

Estimating the effects of supply restriction efforts on drug prices is not simple and straightforward. Although removing product from the market may increase (rather than

decrease) drug traffickers' costs, the extent to which prices are driven upward depends on several factors. Drugs change hands multiple times between import (or production in the case of domestically manufactured drugs) and final sale to the user (Caulkins, 1997a, 1997b). As one moves down through the distribution hierarchy, transaction size gets smaller and the price per unit increases. One implication of the substantial differential between the replacement cost of drugs and their retail value is that law enforcement efforts that remove drugs at the higher levels of the distribution system (where the replacement costs are relatively low) are less damaging to the drug trade than seizures made at the lower levels of the distribution hierarchy (Caulkins & Reuter, 1998). In fact, by weight, most drugs seized come from a few large seizures at the higher levels.

Additionally, because retail prices are much greater than those at the higher market levels, the ability of law enforcement efforts to drive up retail drug prices depends critically on how price increases are transmitted from one level of the hierarchy to those below (Caulkins & Reuter, 1998). If price increases follow an additive model, the efficacy of interdiction efforts to raise prices will be considerably smaller compared to the results if price increases operate in a multiplicative fashion. To date, little research has been conducted to determine which model appears to be most appropriate. With respect to cocaine, (Caulkins & Reuter, 1998) note that near the origins of the distribution chain, the multiplicative model does not seem plausible, and no analyses have been conducted for intermediate level markets because of insufficient data. Finally, it is important to note that policy (i.e., enforcement) is only one determinant of price. With respect to cocaine factors other than enforcement are directly responsible for nearly half of the price of cocaine (Caulkins & Reuter, 1998). Therefore, it is possible for the overall price of a drug to decline even as enforcement stringency increases if the declines in the other cost components more than offset the costs associated with enforcement.

In summary, (Caulkins & Reuter, 1998) point out that specific enforcement interventions (e.g., crackdowns and interdiction) have created spikes in prices with associated benefits for consumption and related problems by creating short-term scarcity. However, the benefits associated with increased prices do not last because suppliers are adept at reacting to market conditions and modifying their operations. As a result of these adaptations, further intensification of enforcement has only modest effects in further raising prices in the long-run.

### *Supply to Meth Use*

The positive association between supply and substance-related problems is mediated by use. Increased supply (all other factors remaining constant) leads to a reduced price and greater consumption. Restrictions on retail availability are intended to limit consumer access to products.

For example, studies that examine variations in retail availability of alcohol have generally found that reduced availability results in lower alcohol consumption (and associated problems). Birckmayer, Holder, Yacoubian, and Friend (Birckmayer, Holder, Yacoubian, & Friend, 2004) report that changes in general alcohol availability in Iceland, Poland, Sweden, and Greenland have been associated with changes in drinking. Studies of specific alcohol intervention to influence retail availability such as restrictions on outlet densities, minimum purchase age laws,

restrictions on hour and days of sale, and implementation of responsible beverage service programs have also been associated with decreased drinking. A smaller literature on retail restrictions on tobacco aimed primarily at youth provides support for the notion that reducing retail access is associated with decreased use.

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 (MacCoun & Reuter, 2001) examined the effects of marijuana depenalization in the Netherlands. Depenalization was not associated with changes in marijuana use changes between 1976 and 1983; however, sharp increases in marijuana use occurred between 1984 and 1996 when commercial access to marijuana increased.

In their study to establish how the public distribution and sales system for illicit drugs is related to the drug consumption system, Freisthler et al. (2005) examined the geographic relationships between availability and self-reported drug use. Use of illegal drugs was significantly positively related to sales of drugs in surrounding geographic areas for both youth (aged 12 to 18) and adults (those 19 years old and older). Interestingly, drug sales within any given area were unrelated to self-reported use among youth and negatively associated with use among adults. Thus, areas of greatest access—at least for adults—are not necessarily the areas of greatest use. Because drug markets are more likely to be located in places immediately adjacent to high drug use areas, prevention efforts may need to be located within different areas of communities to address the issues of sales, use, and related problems.

### **Strategies:**

#### *High-level law enforcement to disrupt drug importation and distribution operations*

One law enforcement strategy aimed at reducing the amount of manufactured methamphetamine that is available for purchase in retail drug markets is drug seizures. Efforts to interdict illicit drugs, including methamphetamine, are undertaken at various levels of government. Federal agencies such as the DEA and U.S. Customs and Border Protection work to interdict meth imported from other countries such as Mexico, where large “super labs” have become the predominant source of meth in the Midwest and West. The DEA and state and local officials are involved in seizing domestic meth labs, surveilling major supply routes and disrupting distribution networks. As discussed above, the long-term effects of such interdiction efforts are tempered by several factors including the relatively cheap replacement costs of drugs seized high in the distribution system and the adaptability of drug traffickers to modify their operations and find new supply routes and new sources of drugs.

#### *Local law enforcement efforts to arrest dealers*

At the local (i.e., neighborhood) level, authorities use an array of techniques aimed at retail sellers to curtail the supply of drugs available for purchase, including massive drug “sweeps” (concentrating uniformed police officers in known drug hotspots resulting in many arrests) and undercover “buy and bust” operations (in which undercover officers purchase drugs from

suspected dealers). Such enforcement activities may, at least temporarily, reduce the quantities of drugs available in the retail market of a given geographical area. However, the entrance into the market of new dealers to replace those who have been removed may make these gains relatively short-lived without a simultaneous reduction in demand. Although not specifically related to meth, police crackdowns in general have had a mixed history of success. In a review, (Davis, 1998) noted that it is widely acknowledged that police crackdowns can reduce the number of drug transactions, although probably only for the duration of the crackdown. Without other efforts accompanying the crackdown, drug sales generally pick up again once police resources are removed (Sherman, 1990); (Worden, Bynum, & Frank, 1994).

Perhaps more important than their potential supply reduction effects, local law enforcement efforts to arrest dealers also help drive a wedge between supply and demand by making it more difficult for sellers and buyers to conduct business. For example, drug sweeps or buy-and-bust operations force drug dealers to move their operations to new locations or to become more discreet in their selling activities. Customers find it more difficult to locate dealers and spend more time searching for drugs. Sweeps also increase the risk of arrest for both drug sellers and buyers. All of these factors serve to increase the nonmonetary costs of drugs and can reduce demand (even though the price of the drugs will probably remain unchanged) (Kleinman, 1992). Such enforcement activities relying on mass arrests can create serious problems, including large numbers of arrestees that the courts are poorly equipped to handle and overcrowding the corrections system (Davis, 1998).

#### *Civil remedies to disrupt local drug markets*

While police crackdowns focus primarily on individuals (i.e., dealers and users), a number of civil remedies use actions targeted at drug selling locations to try to reduce the quantity of drugs sold by making it more difficult for buyers and sellers to engage in the drug trade. For example, in drughouse abatement actions, owners of properties from which drugs are being sold are threatened with civil suits, which can result in fines, closure, or confiscation of the property, unless the drug sales are terminated. Suits are brought under civil nuisance abatement statutes, which have a lower burden of proof than criminal prosecutions. Such programs can be fairly inexpensive and easy to administer as most commonly the owner corrects the problem by evicting the problem tenants after receiving a single letter regarding the problem. Several studies have investigated drug abatement actions and found that they are effective in achieving their immediate goal of eradicating drug activity (Lurigio et al., 1993); (Smith, Davis, Hillenbrand, & Goretzky, 1992). A study by Eck and Wartell (Eck & Wartell, 1998) reported the results of a randomized study of abatement actions, with rental properties where drug sales had occurred being assigned to one of three conditions (letter sent to property owners informing them of drug sales and warning of fines or closure of the building if the problem continued; warning letter plus a request for a meeting between police and property owner; no abatement notice). Follow up over the next 30 months indicated that significantly fewer crimes were reported in the two abatement conditions than in the control condition. Additionally, letters alone were as effective as letters and meetings with police.

Another form of civil remedy, code enforcement, involves community groups using enforcement of local building codes, zoning laws, or health codes to pressure property owners to stop drug sales from being conducted inside or in front of residences. Putting pressure on owners' insurance companies to deny hazard insurance until the drug dealing is stopped has also been used. Little is known about the effectiveness of code enforcement in reducing drug activity. However, a study by Green-Mazerolle, Roehl, and Kadleck (Green-Mazerolle, Roehl, & Kadleck, 1998) used a randomized experiment with 100 drug hotspots assigned to traditional police enforcement (surveillance, arrests, and field interrogation) or traditional police enforcement plus civil enforcement (abatement actions and code enforcement). The properties subject to the civil actions showed a decrease in drug sales and a decline in signs of disorder relative to the properties assigned to traditional police enforcement only.

Despite the promise of civil remedies to reduce drug sales at particular locations targeted by these measures, a number of potential problems exist. With regard to drughouse abatement actions, concern has been raised as: (1) they often result in the eviction of persons already prosecuted and sentenced on criminal charges, (2) innocent family members or other tenants can be evicted with the drug sellers, and (3) they can simply disperse drug dealers without curtailing drug selling activity. Furthermore, statutes that allow authorities to close properties without notifying property owners can infringe on due process rights.

#### *Altering the physical environment to hinder drug selling*

Some community groups have used various strategies to alter the physical environment where drug sales are occurring (e.g., boarding up abandoned houses, cutting back shrubbery in parks, improving lighting) to deny drug dealers a safe haven for conducting business. These strategies are usually not employed alone, but rather are typically a small part of a larger multifaceted prevention effort. Such approaches to preventing drug sales have been borrowed from the broader crime prevention field, where modifications to the physical environment have been used to reduce the occurrence of robberies, burglaries, and other crimes (Jeffrey, 1971); (Newman, 1972). Although a wealth of studies suggest that changes to the built environment can provide significant deterrence to many forms of economic and personal crime, no rigorous studies have tested their effects on retail drug markets.

A common concern with local environmental approaches (including local enforcement actions, civil remedies and alterations to the built environment) is that criminal activity is simply displaced to another location rather than eliminated. Expectations regarding displacement have, perhaps, been highest for environmental control of retail illicit drug sales (Davis, 1998). Police and community activists perceive that drug dealers are particularly recalcitrant, simply moving their operations from a less hospitable locale to one that is more vulnerable. Several studies, however, suggest that displacement effects due to neighborhood anti-drug efforts rarely seem to occur. Displacement has been found in only a few studies of police crackdowns (Sherman, 1990), and little evidence has surfaced in research on drughouse abatement actions (Davis & Lurigio, 1996). Interestingly, Green (Green, 1996) found that not only did a program of code enforcement combined with police crackdowns not lead to displacement effects, it resulted in diffused benefits to the surrounding area. In summary, Davis and Lurigio (Davis & Lurigio,

1996) noted that while displacement is a serious possibility when local retail drug markets are disrupted, it often does not occur or the displaced activities are of a lesser magnitude. In some cases, benefits associated with a local intervention may accrue to the surrounding areas. More research on the displacement of problems and diffusion of benefits is needed.

## **Summary**

Local anti-drug efforts hold considerable promise. Civil remedies, in particular drughouse abatement statutes, seem to be effective in discouraging illicit drug sales and can be instituted with minimal cost. Additionally, civil remedies can be readily used in combination with other local prevention strategies. Less is currently known about the effectiveness of modifying the physical environment to reduce drug sales, although physical design solutions have been shown to discourage many other forms of crime and, like civil remedies, such alterations can be incorporated into multifaceted initiatives. It is important to note, however, that the potential of local environmental efforts to reduce drug selling is tempered to the degree that factors from outside the community contribute to drug problems. For example, a community that lies along a major drug distribution route can do little to change its proximity to large suppliers of drugs. Thus, while local anti-drug approaches may prove to be important tools in fighting drug use and its attendant problems, like many other complex social issues, success will likely require comprehensive efforts.

## **Methamphetamine Beliefs**

**Conceptual Definition:** Methamphetamine beliefs refer to various socio-cognitive influences on substance use behavior: attitudes toward use, expectancies, and perceived social norms. The notion that such beliefs influence substance use behavior is grounded in such theoretical approaches as cognitive social learning theory (e.g., (Bandura, 1986)), problem behavior theory (e.g., (Jessor, Donovan, & Costa, 1991)), the DOMAIN model of drug use (e.g., (Newcomb & Bentler, 1988)), and current reformulations of the Theory of Planned Behavior (Ajzen, 1985), 1988, (Ajzen, 1989); Fishbein, et al., 2002, 2003).

*Attitudes* toward methamphetamine refer to overall affective evaluations regarding the use of meth (e.g., wrong-not wrong; good-bad; pleasant-unpleasant) by an individual.

*Expectancies* about methamphetamine refer to individuals' perceptions of the likelihood of *personally* experiencing various positive and negative consequences as a result of using methamphetamine. Thus, they are the cognitive representations of anticipated rewards and punishments associated with one's use of meth.

*Perceived social norms* refer to individuals' perceptions of the approval or disapproval associated with using meth by others such as peers and parents (injunctive norms) and the extent to which these others use meth themselves (descriptive norms). Thus, injunctive norms describe perceptions of what people ought or ought not to do, while descriptive norms represent perceptions of what others actually do (i.e., the standard behavior).

### **Measurement:**

Surveys on self reported substance use can gather information on respondents' frequency of use and use-related consequences, as well as items on personal beliefs. When young people's substance use attitudes, expectancies and social norms have been assessed, most frequently it has been with respect to alcohol; however, adaptations are easily made to cover other substances, including methamphetamine.

Assessment of attitudes toward alcohol include asking respondents how right or wrong they think it is for someone their age to drink alcoholic beverages, with Likert-type response options (e.g., from "very wrong" to "not wrong at all").

Alcohol expectancy measures list a variety of positive outcomes (e.g., have fun, make me feel more relaxed, make me more outgoing or friendly) and negative consequences (e.g., get into trouble with parents, get a hangover, feel out of control). Respondents use a Likert-type scale with response options such as "very unlikely" to "very likely" to indicate their beliefs about the likelihood of personally experiencing each of the consequences if they were to drink or use other drugs.

Normative beliefs are typically assessed with two different sets of items—one that assesses descriptive norms (i.e., perceived levels and frequency of use by others) and one that taps injunctive norms (i.e., perceived levels of approval or disapproval of the respondent's use by others). Within each set, several items are used referencing different target individuals (e.g., parents, best friends, same-age peers) to gather normative data on a range of proximal and more distal social influences. An example of descriptive alcohol norms involves asking youth to indicate how many of their four best friends have tried beer, wine, or liquor in the past year when their parents didn't know about it; response options range from "none" to "four." Similar items to cover broader social networks may substitute targets such as "your other friends" or "students your age at your school" for four best friends. Similarly, injunctive norms use items asking respondents how wrong their parents feel it would be for them to drink beer, wine, or liquor regularly, with four possible response options from "very wrong" to "not wrong at all." Additional items ask about perceived disapproval of personal use by best friend, other good friends, and other people their age who they know.

**Relationship of the Intermediate Variable to the Problem:** Individuals' substance-related beliefs have been posited as important explanatory constructs in various cognitive-social theories of substance use and abuse. Although most research to date on these constructs has focused on alcohol, the same theoretical mechanisms are presumed to apply to their relationship with tobacco and illicit drug use and related problems. For example, descriptive norms, which provide frequency information about the behavior of important reference figures or groups, are posited to motivate drinking, smoking, and illicit drug use by providing information about what will prove most effective and adaptive in a given situation. Thus, while most empirical evidence of an association between attitudes, expectancies, and norms, on the one hand, and consumption and use-related problems, on the other hand, has been based on studies of alcohol, there is good reason to believe that similar associations exist regarding meth-related attitudes, expectancies and social norms and methamphetamine use and associated harms.

**Relationship of the Intermediate Variable to the Other Variables:**

*Meth Beliefs to Meth Use*

A substantial body of literature—much of it related to alcohol—has examined the relations between ATOD beliefs and use. Significant associations between alcohol outcome expectancies and alcohol use have emerged, with drinking behavior significantly and positively associated with positive expectancies and inversely related to negative outcome expectancies (Christiansen & Goldman, 1983); (Brown, Christiansen, & Goldman, 1987); (Fromme, Stroot, & Kaplan, 1993); (Fromme & D'Amico, 2000). Reviews of risk and protective factors for substance abuse also identify parental and peer approval or disapproval of ATOD use (i.e., injunctive norms) and peer use (descriptive norms) as clearly related to adolescent substance use (Beauvais & Oetting, 1999); (Danseco, Kingery, & Coggeshall, 1999); (Hawkins, Kosterman, Maguin, Catalano, & Arthur, 1997); (McNamara, 1996); (Yuen & Pardeck, 1998). Injunctive norms for adolescent substance use have been shown to help differentiate ATOD abstainers, experimenters, and regular users (Danseco et al., 1999); (McMaster & Winter, 1996) and to predict later alcohol use (Cherry, 1991). Descriptive norms of greater peer use have emerged as one of a number of

factors positively associated with heavy drinking and drunkenness (Barnes, Farrell, & Bannerjee, 1995), earlier initiation of alcohol use (Hawkins et al., 1997), transition to problem drinking (Costa, Jessor, & Turbin, 1999), marijuana use (Hemmelstein, 1995), and overall involvement with drugs (De Witt, Silverman, Goodstadt, & Stoduto, 1995); (Hoffman, 1993).

Although little research exists with respect to methamphetamine specifically, some descriptive findings regarding marijuana suggest that drug attitudes and beliefs are related to use as predicted by theories such as social cognitive theory. Using data from Monitoring the Future, Johnston, O'Malley, Bachman, and Schulenberg (Johnston et al., 2005) reported that the rise in marijuana use in the 1970s and subsequently in the 1990s were related to decreases in youths' perceptions of the risk associated with use. In fact, Johnston and colleagues found that among 10<sup>th</sup> and 12<sup>th</sup> graders, perceived risk began to decline a year before use began to rise in the upturn of the 1990s. The decline in perceived risk halted in 1996 among 8<sup>th</sup> and 10<sup>th</sup> graders and use began to decline a year or two later.

### **Strategies:**

#### *Expectancy challenge*

Expectancy challenge refers to interventions designed to reduce positive outcome expectancies, increase negative outcome expectancies, or both to decrease the chances that participants will engage in unhealthy behaviors. A search of the literature suggests that to date expectancy challenge interventions have been applied exclusively to alcohol, and studies have yielded mixed results. Across four experimental studies of the delivery of expectancy challenges to elementary school-aged children, one study produced consistent but short-term effects (Cruz & Dunn, 2003), another study using two different videotaped models (puppet vs. adult) produced conflicting findings (Kraus, Smith, & Ratner, 1994), and two studies failed to produce changes in alcohol expectancies following intervention or at 3-year follow up (Austin & Johnson, 1997); (Corvo & Persee, 1998). Expectancy challenges applied to college student populations have been inconsistent as well. Two studies (Darkes & Goldman, 1993), (Darkes & Goldman, 1998) found exposure to expectancy challenges related to decreases in both positive alcohol expectancies and alcohol use. Attempts to replicate these findings have been unsuccessful, however, with some studies finding reductions in positive alcohol expectancies without significant reductions in alcohol consumption (Maddock, Wood, Davidoff, Colby, & Monti, 1999); Corbin, Carter, & McNair, 1998). The discrepant findings suggest that the ability of such interventions to affect expectancies and drinking behavior may be dependent on other factors such as participants' age, gender, and prior alcohol use.

#### *Normative education*

Social norms approaches to preventing substance use are based on empirical findings that: (1) youths' perceptions about the prevalence and frequency of peers' use of ATOD is positively associated with personal substance use behavior and (2) youth tend to overestimate how much and how often their peers engage in unhealthy behaviors including substance use. Thus, social norms approaches focus on peer descriptive norms; teens are posited to adopt behaviors they think are the norm in their environment in order to fit in and be accepted (Ott & Doyle, 2005).

Normative education or norms correction interventions work on the assumption that if these misperceptions about unhealthy peer behaviors can be corrected (i.e., adjusted downward), then the likelihood is increased that most youth will either choose not to engage in the behavior or will reduce their participation in the behavior. These interventions often involve collecting data about student behaviors and then communicating actual peer norms, stressing messages about the positive behaviors of the majority of students, including messages about abstinence from ATOD use, safety, and responsibility. Several studies of social norms interventions with middle and high school students have shown success in changing misperceptions and decreasing use or preventing initiation of cigarette smoking and/or alcohol/marijuana use (Haines, Barker, & Rice, 2003); (Hansen & Graham, 1991); (Linkenbach & Perkins, 2003). For example, in a longitudinal study with junior high school students, the social norms approach significantly deterred the onset of tobacco, alcohol and marijuana use one year later compared to a peer resistance program (Hansen & Graham, 1991). In another study, youth who participated in an experimental social norms media campaign were much less likely (41%) than those in the control group to begin smoking in the year following the campaign (Linkenbach & Perkins, 2003).

## **Community Concern about Methamphetamine Harm**

**Conceptual Definition:** Community concern about methamphetamine harm refers to the extent to which there is broad-based awareness and concern about the types and levels of *problems* associated with methamphetamine use within the local community. That is, community concern focuses on the consequences of use and the extent of a community's perceived threat, fear, and anxiety about those harms. (In contrast, community norms represent aggregate approval (or disapproval) of use within a community.) Community concern is often driven by the occurrence of a negative event in the community such as the overdose of a star athlete or the explosion of a home meth lab that injures young children. As a reaction to local events, community concern can increase suddenly and dramatically immediately after such occurrences but then may recede quickly as attention to the event and the community's collective memory for it diminish.

**Measurement:** Local concern about methamphetamine harm can be measured by self-report surveys in a community. The term community is used here to include any geographical area with which individuals identify including neighborhoods, small towns and villages, and sections of large metropolitan areas. It might be possible to infer from a content analysis of local news media (newspaper, radio, or TV) local attention to methamphetamine. This could measure the frequency and amount of media coverage devoted to reports on meth use, related problems, and enforcement, i.e., media coverage such as column inches, number of stories on the local news, etc. as an indicator of the attention and relative importance accorded to the issue. See discussions by Holder and Treno (Holder & Treno, 1997) concerning local news coverage on alcohol.

**Relationship of the Intermediate Variable to the Problem:** There is no direct relationship posited going from community concern to methamphetamine use and associated harm. While methamphetamine harm typically serves as the final dependent variable in the causal model, here it serves as an independent variable (i.e., as the triggering event) for a separate pathway within the model.

### **Relationship of the Intermediate Variable to Other Variables:**

#### *Community Concern about Meth Harms to Community Norms*

Community norms is a macro-level variable reflecting the degree acceptability of meth use. The development or change in underlying community norms is a process that is posited to evolve slowly over time, driven by numerous influences including community concern about harms, which may often serve as the impetus to normative change. For example, the more immediate impact of the 1964 Surgeon General's report on the effects of smoking was to raise awareness and concern about the harms associated with tobacco use; however, the development of less tolerant community-level norms about the acceptability and prevalence of smoking took several decades to occur.

Strong and clearly defined community standards for behavior are most likely to exist over issues that the majority of residents feel are important. If community members are not aware of or particularly concerned about the harms associated with methamphetamine, community norms are likely to be relatively lax and/or ambiguous regarding its use (all other factors being equal) compared to situations in which awareness and concern are heightened. For example, the disclosure of an event such as the drug-related death of someone well-known and well-liked in the community may serve initially to change attitudes of some community members about how dangerous methamphetamine use is and the perceived urgency of dealing with its problems. These initial increases in community awareness and concern may provide significant impetus within at least a significant core of community members for activism directed at reducing the problem. Such efforts may involve pushing for greater law enforcement, advocating new policies (such as limiting access to precursor chemicals), and mounting public information campaigns. In time, these efforts to further raise awareness and concern and deal with the problem may help foster new community norms regarding methamphetamine use.

#### *Community Concern about Meth Harms to Enforcement*

One target of the increased concern about drug problems and associated shift in community norms is law enforcement. That is, following an event that promotes concern about drugs and less tolerance for their use, community members often petition law enforcement agencies to target resources toward the problem—a specific substance, a specific geographic location where drug selling is perceived to be particularly bad and so forth. Although there are many factors that determine how law enforcement agencies allocate their limited resources across problem areas, community concern and mobilization are important factors that can draw attention to a particular problem and make it a priority for enforcement purposes.

#### **Strategies:**

##### *Media Coverage*

Relatively few community members have direct contact with drug dealers and users; thus, most of the information about the prevalence of meth sales, use, and associated problems come from media reports. Mass media coverage of issues provides a useful vehicle for communicating health information to large numbers of persons. The media often report on newly released findings from aggregate data sources such as the NSDUH, although these are typically national-level statistics and trends. The local media also report on community-level events related to drug selling and drug use such as drive by shootings, explosions of meth labs, charges for using or selling brought against community members, and so forth. As media time and space devoted to covering an issue increases, so should community concern.

## **Methamphetamine Production**

**Conceptual Definition:** Production refers to the manufacturing of methamphetamine. Methamphetamine can be easily manufactured in clandestine laboratories (meth labs) using ingredients purchased in local stores. Over-the-counter cold medicines containing ephedrine or pseudoephedrine and other materials are “cooked” in meth labs to make methamphetamine.

**Measurement:** Official data come from local, state, and national seizures of methamphetamine, methamphetamine-related paraphernalia, and precursor chemicals used to manufacture methamphetamine.

**Relationship of the Intermediate Variable to the Problem:** The production of methamphetamine is posited to influence meth use and related problems indirectly through the amount of meth that is made available for retail purchase (supply). Meth labs are often portable and as such are easily dismantled, stored, or moved. This portability helps methamphetamine manufacturers avoid law enforcement authorities. Meth labs have been found in many different types of locations, including apartments, hotel rooms, rented storage spaces, and trucks. Methamphetamine labs have been known to be booby-trapped and lab operators are often well armed.

According to the DEA, there were 12,715 methamphetamine laboratory incidents reported in 46 states in 2001. The West Coast accounted for most of the laboratory incidents. On the East Coast, the following States reported the highest incident rates: Georgia (51), North Carolina (31), and Florida (29). Nationally, the highest rate of lab activity took place in Missouri, which reported 2,207 incidents. California and Washington also had high incident rates with 1,847 and 1,477, respectively.

Methamphetamine production has changed in the US during the past 10 years. Mexican drug trafficking organizations have become the dominant manufacturing and distribution group in cities in the Midwest and the West. Methamphetamine production was previously controlled by independent laboratory operators, such as outlaw motorcycle gangs, which continue to operate but to a smaller extent. The Mexican criminal organizations are able to manufacture in excess of 10 pounds of methamphetamine in a 24-hour period, producing high-purity, low-cost methamphetamine.

Methamphetamine precursor chemicals include pseudoephedrine and ephedrine drug products. Mexican organizations sometimes use methylsulfonylmethane (MSM) to “cut” the methamphetamine in the production cycle. MSM is legitimately used as a dietary supplement for horses and humans. The supplement is readily available at feed/livestock stores and in health/nutrition stores. By adding MSM, the volume of methamphetamine produced is increased, which in turn increases the profits for the dealer.

The geography of meth production may also help explain some of the demographic patterns in methamphetamine use. Although the majority of meth available in urban areas is produced and distributed by drug cartels running super labs in Mexico and California, a considerable amount

of domestic production occurs through thousands of small, clandestine labs operating across the country. Rural areas have been particularly susceptible to methamphetamine production and distribution for a variety of reasons: (1) limited resources for law enforcement make detection less likely than in urban areas, (2) wide, open spaces facilitate production as the cooking process emits pungent odors, and (3) increased access to certain ingredients such as anhydrous ammonia, (commonly used in fertilizer) that are not available in stores but can easily be stolen from storage tanks on farms (Kraman, 2004). In rural areas, there is considerably less population heterogeneity compared to urban and suburban locales; the population is primarily comprised of white, males between the ages of 18 and 35 holding blue-collar jobs and one of the major socio-demographic groups of meth users. A recent report notes that a growing body of evidence points to meth abuse as one reason substance abuse rates among rural and small-town youth are higher than those among urban youth (Kraman, 2004). With respect to meth in particular, rural eighth graders were 59% more likely than youth in large cities and 64% more likely than those in small metropolitan areas to use methamphetamine (National Center on Addiction and Substance Abuse at Columbia University, 2000).

### **Relationship of the Intermediate Variable to Other Variables:**

#### *Meth Production to Supply/Availability for Purchase*

Meth production and its supply/physical availability are very closely and positively related. Supply/physical availability is largely dependent on the quantities of meth produced and presumably nearly all that is produced (minus what is removed through interdiction efforts personal use) is made available to retail drug markets. Thus, as meth production increases so should the supply available for retail sale.

### **Strategies:**

We hypothesize an indirect and positive relationship between methamphetamine production and its subsequent use and associated problems. We posit that decreases in methamphetamine production will reduce the supply of meth available for purchase and increase the price of meth, which will then lead to decreased use and fewer associated problems. Strategies for affecting the amount of meth that can be produced focus primarily on reducing the number of labs manufacturing meth and decreasing access to precursor chemicals.

#### *Law Enforcement Efforts to Dismantle Meth Labs*

As noted above, manufacturing of meth occurs in clandestine labs that are easily dismantled, moved, or stored and uses readily available chemicals. These factors not only make it difficult for law enforcement to find them and seize the labs, but it means that it is fairly easy for new manufacturers to fill the void. Also, as described above, production of meth has increasingly moved from independent lab operators in the U.S. to labs in Mexico. This shift in the location of meth production means that efforts to seize domestic labs—even if successful—can not capture all of the methamphetamine produced for retail sale. Thus, in addition to domestic lab seizures,

law enforcement efforts in the U.S. need to focus on post-production supply side efforts such as disrupting supply networks and distribution operations to keep meth from the retail drug markets.

*Implement Regulations on Precursor Chemicals*

The evidence regarding the effectiveness of methamphetamine precursor regulations is mixed. Cunningham and Liu (Cunningham & Liu, 2003) reported that three different regulations imposed in 1989, 1995, and 1997 were associated with sharp reductions in meth-related hospital admissions in three western US states. As the precursor regulations would not have affected the harmfulness of methamphetamine produced and sold, the reductions in hospital admissions presumably came about through reductions in prevalence of use or total consumption. However, when Reuter and Caulkins (Reuter & Caulkins, 2003) examined other indicators of methamphetamine supply and consumption (including price, prevalence among arrestees, treatment admissions, drug use survey results and emergency department mentions), evidence regarding the effectiveness of regulation was ambiguous. For example, although there was a 9-month increase in the price of meth in 1989, there was no attendant increase in 1995 and only a small 3-month increase in price in the last quarter of 1997. Similarly, data from the ADAM Program were likewise inconsistent, with evidence of a substantial downturn in positive rates among arrestees following the August 1995 regulation, but not following the 1997 regulation. Additionally, estimates from the 1999-2001 National Household Survey on Drug Abuse of the annual incidence of methamphetamine use from 1965 to 2000 showed no downturn following the precursor regulations.

## **Perceived Risk of Arrest**

**Conceptual Definition:** Activities on both the supply side (e.g., production, distribution, and sale of meth) and the demand side (e.g., purchase of meth) are illegal. Perceived risk of arrest by suppliers is the personal assessment of a methamphetamine seller/manufacturer of his/her personal risk of being detected and arrested by law enforcement for selling/manufacturing methamphetamine. Perceived risk of arrest by drug users is their personal assessment of the likelihood of being detected and arrested by law enforcement for purchasing methamphetamine.

**Measurement:** Self-report data can measure the extent to which suppliers and purchasers perceive risk of arrest/apprehension and subsequent punishment. It has also been postulated that the number of meth labs may serve as a surrogate for level of perceived risk of arrest for production. That is, when overall perceived risk of arrest is low, producers and suppliers may be more comfortable having labs and engaging in production and distribution.

**Relationship of the Intermediate Variable to the Problem:** Perceptions of the likelihood of being arrested for production, sales, or possession of methamphetamine are posited to affect use and meth-associated harm directly as well as indirectly through changing market conditions. Traditionally, law enforcement efforts directed at illicit behavior apprehend offenders on the assumption that such practices will deter other people from such behavior in the future (general deterrence) and that such practices will prevent apprehended offenders from repeating their own behavior (specific deterrence). Research has shown that as the actual and/or perceived likelihood of being detected and arrested or cited for law violations increased, so does compliance. Ross (Ross, 1982) reported that *perceived* enforcement might be more important in successful outcomes than *actual* enforcement, at least initially. The perception, however, would eventually need to match reality for the deterrent effect to be sustained (Vingilis & Coulters, 1990); Hingis et al., 1988).

In addition to the direct effects of deterrence on use, police activity such as highly visible and well publicized buy and bust operations may affect use by changing market conditions. As the risk of being apprehended for drug manufacturing and drug selling increases, producers' and dealers' nonmonetary costs go up, which may trigger a reduction in the quantity of meth produced and the amount available for sale, leading to higher drug prices. In turn, this increase in price may lead some users to reduce the amount they use or stop using meth altogether.

### **Relationship of the Intermediate Variable to the Other Variables:**

#### *Perceived Risk of Arrest to Meth Production*

General deterrence theory proposes that knowledge both of the illegality of an act and the penalties that will be meted out for committing it will reduce the likelihood that people will engage in unwanted behavior. That is, general deterrence strategies influence risk perceptions and negative consequences in an effort to motivate behavior change. Laws prohibiting driving after drinking, tobacco sales to minors, and use and possession of illicit drugs are general

deterrent measures. For deterrent measures to be most effective in preventing substance-related problems, sanctions need to be swift, certain, and meaningful (Ross, 1982) and people must believe that if they violate the law, they will be caught (i.e., risk of apprehension is significant). Ross (Ross, 1982) reported that perceived enforcement might be more important in successful outcomes than actual enforcement, at least initially. The perception, however, may eventually need to match reality for the deterrent effect to be sustained (Hingson, Howland, & Levenson, 1988); (Vingilis & Coultres, 1990).

The importance of perceived risk in determining driver behavior has been recognized by researchers concerned with drinking and driving (Reed, 1981); (Ross, McCleary, & Epperlein, 1981); (Voas, 1982a, 1982b, 1982c; Voas & Tarrant, 1982; Voas, 1982e, 1982d). For example, the actual risk of arrest for DUI is fairly low and the public seems to accurately perceive this. However, when changes in traffic enforcement are implemented and publicity is widespread, the public may over-estimate the new, increased risk at least for a time—and the amount of drinking and driving declines. When it becomes clear that the actual risk of arrest has not risen appreciably, however, the public tends back toward its former behavior, and drinking and driving once again increases (Ross et al., 1981).

Little or no research on the behavior of drug producers and their risk perceptions exists. Assuming that the mechanism of general deterrence applies, it can be postulated that increasing drug producers' perceived risk of arrest will be associated with reduced production of methamphetamine.

#### *Perceived Risk of Arrest to Supply Available for Purchase*

During the past 25 years, large amounts of resources have been invested in supply-oriented enforcement, with the risk of incarceration given participation in drug selling perhaps having tripled between 1980 and 2000 (Caulkins et al., 2006). As noted earlier, despite the increased risks of imprisonment and higher costs to dealers associated with tougher enforcement, prices for several drugs—cocaine, heroin, and methamphetamine—have all declined markedly. Even if enforcement activities did not drive up drug prices, they might still be considered successful if they affected supply, making drugs more scarce. However, data on perceived availability of drugs, like cocaine and marijuana, suggest that there has not been an attendant decrease in access. For example, using data from Monitoring the Future study, Reuter (Reuter, 2001) pointed out that the percentage of high school seniors reporting that marijuana was available or readily available has remained between 80 and 90 percent without any discernible trend since 1975. Availability appears to have been stable for cocaine as well. One possible explanation for why increases in perceived risks and hence the costs of drug selling do not translate into a reduction in supply is that risks incurred represent real costs, but they are not paid in dollar terms. As Caulkins and Reuter (Caulkins & Reuter, 1998) note, “. . . therefore, the accounting profits of dealers (dollar revenues minus dollar costs) can be very large even if the economic profits (revenues minus dollar costs minus dollar value of non-monetary costs incurred) are small. This type of economic perspective suggests that the drug supply system accounts for other threats to net profits by allowing for enforcement, reduce wholesale supply, and threat of punishment in their accounting. This suggests that methamphetamine suppliers can remain in

business even when enforcement and punishment threats remain high. Boyum (as cited in (Caulkins & Reuter, 1998)) observed that this implies dealers are not essentially “driven out of business by negative accounting profits, a common reason legitimate businesses close.” Thus as long as net profits are positive, then other threats to profit can be accommodated. However, if due to reduced supply and enforcement, net profit (revenues less cost of supply) is negative, then illicit drug supply is subject to the same economic forces as legitimate businesses.

#### *Perceived Risk of Arrest to Meth Use*

As with producers of methamphetamine, it is posited that risk perceptions regarding arrest can also motivate the behavior of meth users (see discussion of general deterrence under subsection “perceived risk of arrest to meth production.”). As the perceived threat of arrest increases, users may also increase their compliance with laws prohibiting drug purchase, possession, and use. It is noted, however, that the relationship between risk perceptions and illicit drug use may be complicated by factors such as addiction. Thus, the efficacy of enforcement efforts to create behavior change may be more limited than in the cases of legal substances such as alcohol and tobacco.

#### **Strategies:**

##### *Increased Law Enforcement Efforts to Arrest Drug Producers and Sellers*

If actual enforcement efforts lead to increased arrests and subsequent serious punishments, potential and repeat offenders should be deterred from engaging in methamphetamine sale and/or production. This deterrence should then lead to reduced methamphetamine production.

Because of its illegality and the role of violence in maintaining turf, drug selling has large non-monetary costs. For cocaine, compensation for risk of prison was estimated at 24% of its retail price and compensation for physical risk/harm was estimated at 33% (Caulkins & Reuter, 1998). Thus, individuals who place relatively lower value on such costs have a significant comparative advantage in providing “drug dealing services.” Drug dealing, therefore, may be dominated by people who are relatively less averse to the risks of criminal justice sanctions and physical harm. To the extent that such predilections may hold, the ability of increased enforcement to alter dealers’ risk perceptions may be limited.

As described previously under supply and price, irregularities in illicit drug markets can lead to perverse and unexpected outcomes when enforcement efforts are applied (Caulkins et al., 2006). One important way, however, in which enforcement targeting marginal (i.e., low-level) dealers may have a positive effect is through its demand-side effect. Retail dealers are often heavy users of the drugs they sell. By removing them from the marketplace and incarcerating them, enforcement efforts aimed at dealers can have two effects: one on supply and the other on demand.

*Increased Law Enforcement Efforts to Arrest and Prosecute Drug Users*

In addition to supply side policies, enforcement actions may also be targeted at drug users through increased arrests and prosecution for purchase and possession. Such enforcement efforts are expected to increase users' perceived risks of being arrested and penalized, shifting the demand curve down. However, just as enforcement actions targeting dealers may produce unexpected and counterintuitive effects, the same is true for enforcement aimed at users (Caulkins et al., 2006). For example, although increased enforcement of laws against sales and possession may be effective in driving the demand curve downward and reducing both equilibrium price and quantity, drug users' fear of arrest may lead them to seek out dealers who are able to make sales in more secure locations that offer users' a reduced chance of detection and arrest. As more users avoid marginal dealers in less favorable locations, the prices they can charge will fall while those commanded by dealers in more favorable locations will rise. To the extent that dealers with more favorable locations secure them through violence, enforcement focused at consumers may have the effect of increasing the profits of infra-marginal dealers and the returns to violence.

Although research on enforcement (increased policing or sanctions) has almost uniformly failed to show reductions in either drug prevalence or drug-related harms, it may hold promise as a mechanism for getting drug users (including drug dealers, a high proportion of whom are users) into treatment. Users arrested may be offered drug treatment among sanctions meted out by the criminal justice system. For other users who are not arrested, enforcement actions and the increased threat of arrest may provide the impetus for seeking treatment. A considerable literature on treatment for drug addiction exists, demonstrating that treatment is both effective and cost-effective (Reuter & Pollack, 2006). In addition to reducing an individual patient's drug use, treatment is associated with improved health and employment outcomes, and reductions in the risk of serious harms including overdose, crime, and HIV infection ((National Consensus Development Panel on Effective Medical Treatment of Opiate Addiction, 1988); (IOM, 2000); (Stewart, Gossop, & Marsden, 2002).

## **Methamphetamine Laws about Production, Sale & Possession**

**Conceptual Definition:** Prohibitions against the production of methamphetamine and restrictions on the precursor chemicals used in meth production are contained in national legislation. Both federal and state laws exist which define methamphetamine as a controlled substance such that its sale and possession are illegal.

**Measurement:** Self-report data can measure the extent to which suppliers and purchasers of meth are aware of the existence of methamphetamine laws and the penalties they carry.

**Relationship of the Intermediate Variable to the Problem:** The Controlled Substances Act of 1970 categorized methamphetamine as a Schedule II drug and makes it illegal to produce or consume methamphetamine without a prescription.

The chemicals used to produce methamphetamine are controlled under the Comprehensive Methamphetamine Control Act of 1996. This legislation broadened the restrictions on chemicals used in the production of methamphetamine, increased penalties for the trafficking and manufacturing of methamphetamine and listed chemicals, and expanded the controls of products containing the licit chemicals ephedrine, pseudoephedrine, and phenylpropanolamine.

The Methamphetamine Anti-Proliferation Act was passed in July 2000 and reduced the amount of pseudoephedrine that could be purchased. The act strengthens sentencing guidelines and provides training for Federal and State law enforcement officers on methamphetamine investigations and the handling of the chemicals used in clandestine meth labs. It also puts in place controls on the distribution of the chemical ingredients used in methamphetamine production and expands prevention efforts. In addition, some states have enacted legislation requiring medicine containing pseudoephedrine to be sold by a licensed pharmacist with customers showing ID and signing for it.

We posit an indirect relationship between the enactment of laws related to methamphetamine production, sales, and possession and subsequent use and associated problems. The relationship is mediated by perceived risk of arrest and punishment, methamphetamine production, price, and physical availability.

### **Relationship of the Intermediate Variable to the Other Variables:**

#### *Laws about Meth Production, Sales, and Possession and Perceived Risk of Arrest*

The act of designating a substance as illegal increases its retail price because of the many cost inefficiencies that are introduced by prohibition and the associated threat of detection and arrest (Caulkins & Reuter, 1998). Compared to other highly priced but legal products such as gold and diamonds, drugs such as cocaine and heroin are considerably more expensive—on the order of 10 to 100 times more costly per ounce—despite the fact that they are not scarce. Importation must be done surreptitiously to avoid detection, which may include additional costs such as

paying smugglers, customs officials, and others to move the drugs from the source country. Labor costs are increased as the maintenance of dedicated, fixed capital equipment is too risky; therefore, processing and packaging are done by hand. The need for sellers to have protection from robbery, look out for police and frequent runs to obtain drugs as keeping a large cache at the point of sale is too risky also contribute to labor costs. The loss of product due to law enforcement seizures adds to producers and sellers costs of doing business. Finally, risk compensation for physical injury inherent in drug trafficking (where violence confers competitive advantage) as well as for possible arrest and incarceration accounts for over half of the retail price of cocaine. Thus, Caulkins and Reuter (Caulkins & Reuter, 1998) conclude that prohibition plus some modest degree of enforcement can drive prices far above what they would be if the drugs were legal.

### **Strategies:**

#### *Enact Harsher Penalties for the Sale/Possession of Methamphetamine*

As discussed above, prohibiting the sale and possession of drugs helps raise drug prices substantially over what they would be if drugs were legal. One cost component of retail drug prices is compensation for the risk of imprisonment. Authorities often seek to maximize this cost component as a direct way to deter drug use and drug selling, over and above its effect through price. Penalties are meant to impose considerable costs on individuals who break the law so that individuals who do not sell or use drugs will choose not to do so in the future (general deterrence) and those offenders who have been apprehended will not repeat their behavior (specific deterrence).

Sanctions for drug selling and drug possession have been made tougher in a number of ways. For example, zero tolerance policies, or policies that impose equally severe penalties for all levels of drug offenses have become increasingly popular. However, such policies may actually stimulate drug consumption (Caulkins, 1993).

Another way in which penalties to drug sellers and users have been increased is through mandatory minimum drug sentences, which require judges to impose a sentence of at least a specified length if certain criteria are met. Such sentencing laws help increase the certainty and severity of the penalties meted out to drug offenders. In addition to serving as a deterrent, minimum sentencing laws may also be viewed as a means of achieving the nation's drug control objectives—decreasing drug consumption and related consequences. In an analysis comparing mandatory minimum sentences to other means of demand and drug-related crime reduction, Caulkins (Caulkins, 1997a) found that with respect to cocaine, mandatory minimum sentences reduce cocaine consumption less per million taxpayer dollars spent than spending the same amount on enforcement under the previous sentencing regime. Additionally, both enforcement approaches reduced drug consumption less, per million dollars spent, than putting heavy users through treatment programs. Caulkins explains that conventional enforcement is more cost-effective than mandatory minimums because “Drug enforcement imposes costs on dealers through arrest and conviction, which includes seizure of drugs and other assets, and through incarceration, which involves loss of income. It turns out that, *per dollar spent*, the cost burden

from seizures is greater. A million dollars spent extending sentences thus imposes less cost on dealers—and consequently reduces cocaine consumption less—than a million dollars spent on conventional enforcement, which includes asset seizures.” (p.3) Spending additional money arresting, prosecuting, and sentencing more dealers to standard prison terms has more impact than sentencing fewer dealers to longer, mandatory terms. With regard to cocaine-related crime, they found that mandatory minimum sentences are also less cost-effective than either alternative, principally due to the high cost of incarceration.

*Criminalize the Importation and Possession of all Precursor Chemicals*

The evidence regarding the effectiveness of methamphetamine precursor regulations is mixed. Cunningham and Liu (Cunningham & Liu, 2003) reported that three different regulations imposed in 1989, 1995, and 1997 each were associated with sharp reductions in meth-related hospital admissions in three western US states. As the precursor regulations would not have affected the harmfulness of methamphetamine produced and sold, the reductions in hospital admissions presumably came about through reductions in prevalence of use or total consumption. However, when Reuter and Caulkins (Reuter & Caulkins, 2003) examined other indicators of methamphetamine supply and consumption (including price, prevalence among arrestees, treatment admissions, drug use survey results and emergency department mentions), evidence regarding the effectiveness of regulation was ambiguous. For example, although there was a nine-month increase in the price of meth in 1989, there was no attendant increase in 1995 and only a small 3-month increase in price in the last quarter of 1997. Similarly, data from the ADAM Program were likewise inconsistent, with evidence of a substantial downturn in positive rates among arrestees following the August 1995 regulation, but not following the 1997 regulation. Additionally, estimates from the 1999-2001 National Household Survey on Drug Abuse of the annual incidence of methamphetamine use from 1965 to 2000 showed no downturn following the precursor regulations.

*Enact Harsher Penalties for the Manufacturing of Methamphetamine and the Importation/use of all Precursor Chemicals used in its Manufacturing*

## Enforcement

**Conceptual Definition:** Enforcement of formal policies is an important variable in any causal model. While the mere existence of laws and administrative regulations can influence methamphetamine use, 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. There are two types of methamphetamine-related law enforcement efforts: 1) visible law enforcement efforts which involve overt interdictions to reduce the manufacturing of methamphetamine in the US and internationally and to reduce the importation of methamphetamine precursor chemicals (see (Rydell, Caulkins, & Everingham, 1996); (Weatherburn & Lind, 1997); (Yuan & Caulkins, 1998); (Wood et al., 2003); and 2) invisible law enforcement targeting methamphetamine sale within informal, social networks.

**Measurement:** Enforcement efforts are measured, indirectly, by funding allocated for such efforts, the frequency of drugs seized/eradicated, and the quantity of pills/chemicals seized/eradicated.

**Relationship of the Intermediate Variable to the Problem:** We posit that successful *visible* enforcement efforts (e.g., reducing the quantity of precursor chemicals imported into the US and increasing undercover law enforcement efforts) will increase perceived risk of arrest. Increased perceived risk of arrest should lead to less methamphetamine production. This decreased production will result in both increased methamphetamine prices and reduced physical availability. Increased costs and reduced supply should, according to the drug-price literature, increase the price of methamphetamine. As the price of methamphetamine increases, use and associated problems should decrease.

There is some evidence that the 2000 Methamphetamine Anti-Proliferation Act reduced the number of methamphetamine-related hospital admissions until alternative precursors were identified. Some research has shown that limiting the amount of precursor chemicals reduces methamphetamine use, but the general illicit drug literature is not as optimistic that high-yielding law enforcements can have a serious effect on physical availability and subsequent use. Rydell et al. (Rydell et al., 1996), Weatherburn and Lind (Weatherburn & Lind, 1997), Yuan and Caulkins (Yuan & Caulkins, 1998), and Wood and colleagues (Wood et al., 2003), for example, found no relationship between large-scale drug seizures and use and perceived availability of drugs. As noted previously in the sections on supply and price, the effects of high-level enforcement (i.e., those activities targeted at drug traffickers handling drugs at importation or shortly thereafter) are tempered by several factors including the relatively cheap replacement costs of drugs seized high in the distribution system and the ability of drug traffickers to successfully modify their operations and find new supply routes and sources of drugs.

In contrast, local law enforcement efforts (e.g., drug sweeps, buy and bust operations) have shown more promise in reducing the number of drug transactions, although probably only for the duration of the enforcement action (Davis, 1998). Reuter, Haaga, Murphy, and Praskac, (Reuter, Haaga, Murphy, & Praskac, 1988) found that significant drug deal arrests in Washington, DC,

did not significantly interfere with the surge of drug sales. 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 (Sviridoff & Hillsman, 1994). Drug sales generally picked up again after police resources are removed (Eck & Wartell, 1998); (Lurigio et al., 1993); (Sherman, 1990). Thus, specific enforcement interventions such as crackdowns and interdiction have created short-term scarcity and spikes in prices with associated benefits for consumption and related problems; however, these are generally short-lived as suppliers and dealers adapt to market conditions (Caulkins & Reuter, 1998). In addition to the transient nature of their effects, the oddities of illicit drug markets mean that local enforcement activities may create counterproductive effects, such as when the removal of an extremely violent dealer from a neighborhood reduces marginal costs and leads to an expansion in the number of dealers. Studies of drug abatement actions, in which owners of properties from which drugs are being sold are threatened with civil suits unless drug sales are terminated, have found these actions effective in achieving their immediate goal of eradicating drug activity (Smith et al., 1992).

Additional evidence to explore the relationship between enforcement and use or problems comes from studies of 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 (Caulkins, 1993) noted that “zero-tolerance” policies, or policies that impose equally severe sanctions for all levels of drug offenses, may actually stimulate drug consumption. In an analysis of various means of demand and drug-related crime reduction, mandatory minimum sentences were found to reduce cocaine consumption less per million taxpayer dollars spent than spending the same amount on enforcement under the previous sentencing regime (Caulkins, 1997a). Additionally, both enforcement approaches reduced drug consumption less, per million dollars spent, than putting heavy users into treatment. Interestingly, the Netherlands’ formal policy of nonenforcement for violations of cannabis possession had virtually no effect on levels of marijuana use (MacCoun & Reuter, 2001). Taken collectively, marginal changes in enforcement efforts have done little to change long-term illicit drug use patterns or problems. That said, based upon the prior research from drinking and driving, it is reasonable to postulate the existence and potential importance of such an intermediate variable.

A small body of literature (Rodriguez et al., 2005); (Eck, 1995) suggests that methamphetamine markets differ from those for cocaine and heroin. While cocaine and heroin are sold overtly on the streets to strangers, methamphetamine is sold covertly within well-established social networks (Rodriguez et al., 2005); (Eck, 1995). These findings suggest that traditional street-level enforcement efforts may not be as successful with methamphetamine. Instead, sting operations or enforcement efforts which involve undercover operations within the meth supply and user communities may be more successful in reducing methamphetamine availability. We posit that increased undercover enforcement efforts could have an indirect, negative impact on methamphetamine use. That is, by increasing undercover enforcement efforts, perceived risk of arrest could increase. An actual increase in perceived risk of arrest can lead to less methamphetamine production. This decreased production will result in both increased methamphetamine prices and reduced physical availability. Increased costs and reduced supply should increase the price of methamphetamine. As the price of methamphetamine increases, use and associated problems should decrease.

## **Relationship of the Intermediate Variable to Other Variables:**

### *Enforcement to Meth Production*

One indicator of meth production is lab seizures. Despite the enactment of precursor regulations in 1995, 1997 and 2000, national level data indicate that the number of meth lab seizures has been steadily growing from 327 in 1995 to 13,092 in 2001 (Kraman, 2004). Although such results appear somewhat inconsistent with expectations—that increased enforcement should lead to decreased production—it is important to keep in mind that lab seizures are a measure of enforcement activity and thus do not represent the quantity of meth produced. Additionally, as more of the meth consumed in the U.S. has been coming from Mexico during the past decade, domestic lab seizures are increasingly inadequate as an indicator of production. Thus, it is difficult to know what the relationship between increased regulation of precursor chemicals and meth production has been—whether production has decreased overall, whether it has been simply displaced from U.S. to Mexico with no change in quantity produced, or whether it has declined.

## **Strategies:**

### *Criminalize the Importation and Possession of all Precursor Chemicals*

The evidence regarding the effectiveness of methamphetamine precursor regulations is mixed. Cunningham and Liu (Cunningham & Liu, 2003) reported that three different regulations imposed in 1989, 1995, and 1997 were each associated with sharp reductions in meth-related hospital admissions in three western US states. As the precursor regulations would not have affected the harmfulness of methamphetamine produced and sold, the reductions in hospital admissions presumably came about through reductions in prevalence of use or total consumption. However, when Reuter and Caulkins (Reuter & Caulkins, 2003) examined other indicators of methamphetamine supply and consumption (including price, prevalence among arrestees, treatment admissions, drug use survey results and emergency department mentions), evidence regarding the effectiveness of regulation was ambiguous. For example, although there was a nine-month increase in the price of meth in 1989, there was no attendant increase in 1995 and only a small 3-month increase in price in the last quarter of 1997. Similarly, data from the ADAM Program were likewise inconsistent, with evidence of a substantial downturn in positive rates among arrestees following the August 1995 regulation, but not following the 1997 regulation. Additionally, estimates from the 1999-2001 National Household Survey on Drug Abuse of the annual incidence of methamphetamine use from 1965 to 2000 showed no downturn following the precursor regulations.

### *Police Infiltration of Social Networks through Undercover Operations*

This strategy, which utilizes enforcement agents as undercover participants in the meth production and retail supply systems, appears to have particular potential for increasing the actual and perceived risk for producers and suppliers. Because it appears that much of meth

retail supply is sold via “known” sources (i.e., that users have experience with these sources), then random unexpected enforcement can be less effective. Undercover agents who participate in the methamphetamine production and supply channels have significant potential to increase perception of risk.

### *Link Enforcement and Treatment*

In dealing with drug problems, enforcement serves several purposes (Caulkins, Reuter, Iguchi, & Chiesa, 2005). It is critical in giving “teeth” to prohibition by influencing market participants’ perceptions about likelihood of detection and apprehension. Additionally, enforcement can shape the market into less destructive forms, even if it does not reduce its absolute size. As noted previously, however, heightened enforcement has its limits. In particular for an established, mass market drug, heightened enforcement has been shown to be relatively ineffective at suppressing the quantity of drug consumed and the associated crime and violence. In contrast, treatment can cost-effectively reduce consumption and its use-related harms. Potentially enforcement offers a way of identifying those individuals in need of treatment (e.g., heavy users). Combining enforcement with treatment may be particularly useful in addressing supply and demand. Although some cooperation currently exists between strategies, it can be made more explicit and purposeful. For example, drunk driving, drug courts and other forms of required treatment use sanctions (e.g., jail) as an incentive to maintain clients’ participation in treatment. A variant, termed “coerced abstinence,” would require probationers or parolees to stay clean (i.e., test negative for drugs) or face imprisonment.

## Community Norms

**Conceptual Definition:** Community norms are the level of community acceptability of methamphetamine use and associated support for enforcement of laws (Birckmayer et al., 2004). In general, such norms are informal macro-level values that govern the acceptability or unacceptability of certain behaviors, including substance use. Varying across cultures, contexts, and subgroups, these community norms reflect general attitudes about drug use and societal expectations regarding the level and type of use which is considered appropriate.

**Measurement:** Community norms are typically measured by self-report surveys and indirectly through an examination of community activism.

**Relationship of the Intermediate Variable to the Problem:** As expressions of community values and norms, national drug policies can provide evidence of prevailing norms. In Australia, national policy emphasizes harm minimization (Bammer, Hall, Hamilton, & Ali, 2002), while Sweden emphasizes a more conservative drug control policy, characterized by a reduction of treatment and prevention and an emphasis on punishment.

The relationship between community norms and use is not clear. This is not entirely surprising, as the process through which attitudinal change occurs and then culminates in a broad-based normative shift that influences use patterns and associated consequences is one that unfolds over time in a lagged fashion. The process is often initiated when information becomes available about a health hazard. The dissemination of this information may initially raise awareness and concern, producing attitude change among a small core of the community. In time, the efforts of public health institutions, government, and community activists to shift public thinking and sentiments on the issue may succeed in creating a sea change within the community. As these new attitudes are collectively expressed as newly established community norms of what is acceptable, behavior change and/or policies that support behavior change follow. Thus, at any one particular point in time if any of these variables (attitudes, norms, public policy and behavior) are in flux, they may be out of sync with the others. For example, prior to 1980, community norms in the U.S. were generally accepting of smokers' rights to light up where they pleased and laws and policies tended to reflect this tolerance. During the 1970s, however, spurred by the 1964 Surgeon General's report on smoking and despite prevailing social norms, the government and public health advocacy groups began conducting anti-smoking campaigns to raise public awareness about the health consequences of smoking and exposure to secondhand smoke. By the early to mid 1980s, public attitudes began to shift. As increasingly intolerant attitudes toward smoking became solidified into broad-based community norms, changes were made to laws and policies to codify these new values such as through the passage of clean air ordinances that severely restricted or prohibited smoking indoors. Undoubtedly these policy changes reinforced further adoption of the new community norms. With respect to smoking, the evolution from increased awareness and concern, initial attitude shift, new community norms, and the adoption of public policy consistent with the new social norms took two to three decades to complete.

Based on evidence from other ATOD research, we postulate that norms can influence individual use of methamphetamine through changes in meth-related beliefs. In addition to changing attitudes, norms, and expectancies, an important aspect of community norms concerns support for the enforcement of existing laws. As police resources are limited, decisions must always be made about which public safety problems deserve greater attention and which laws should be the focus of enforcement efforts. Such decisions are based on a variety of factors including the seriousness and extent of harm caused by different problems and the costs associated with them. In addition to such considerations, public sentiments or community norms help shape decisions about how to focus enforcement resources by identifying the problems that the community feels are a priority for law enforcement intervention. While regulations, laws, and administrative restrictions can, by themselves, influence ATOD use and associated problems, the effect size is magnified and effects are maintained over time when there are consequences for violations brought about through enforcement.

### **Relationship of the Intermediate Variable to Other Variables:**

#### *Community Norms to Enforcement*

We hypothesize a direct relationship between community norms and enforcement. The community is a dynamic and influential aggregate of persons who can impact, to varying degrees, how local law enforcement agencies perform their duties and focus their resources. For example, a triggering event within a community (e.g., drug-related death of someone well-known and well-liked) may result in an increased level of drug awareness and activism. As part of their response, community leaders and organizations may petition the police to increase enforcement. Responding to the prevailing community norm, law enforcement agencies increase their attention on the issue, believing that public outrage would ensue if the community's needs are not satisfied. Davis (Davis, 1998) points out that despite the potential problems associated with police actions involving mass arrests (e.g., overwhelming the courts with cases associated with low-level dealers and users, possible infringements on civil liberties), residents of inner city neighborhoods blighted by drug sales have repeatedly called for police crackdowns and police have responded.

#### *Community Norms to Meth Beliefs*

We also posit a direct relationship from community norms to meth beliefs. Because the community, at its core, is composed of individuals, we hypothesize that an aggregate representation of sentiment will be internalized to individual members. Specifically, perceptions of the broader community's sentiments and values about ATOD use is expected to influence individuals' attitudes about use, expectancies about positive and negative consequences of ATOD use, and perceptions of the prevalence and acceptability of ATOD use among more distal reference groups (i.e., social norms).

## **Strategies:**

### *Media Coverage*

As described above, efforts to change community norms often start by raising residents' awareness of a problem and concern about its consequences. Media attention is most likely to raise awareness and concern when it comes from outlets which are relevant to local residents. Relatively few community members have direct contact with drug dealers and users; thus, most of the information about the prevalence of meth sales, use, and associated problems come from media reports. Mass media coverage of issues provides a useful vehicle for communicating health information to large numbers of persons. The media often report on newly released findings from aggregate data sources such as the NSDUH, although these are typically national-level statistics and trends. The local media also report on community-level events related to drug selling and drug use such as drive by shootings, explosions of meth labs, charges for possession or drug selling brought against community members, and so forth. As media time and space devoted to covering a local issue increases, so should community concern.

### *Community Mobilization*

In addition to coverage provided by professional media outlets, grassroots efforts within the community can also be critical to promoting normative change. Community mobilization refers to actions undertaken to reach, influence, enable and involve key segments of the community in collective efforts to create a changed environment in ways that will significantly improve the quality of life. The changes brought about by community mobilization are intended to be broad-based, resulting in better outcomes for everyone living within the community in contrast to more traditional interventions, which often use relatively defined and discrete mechanisms for addressing social policy goals such as through new services or programs. A tactic for developing a community approach to meth problems may be to form a community coalition involving various influential groups (such as the police, the health department, schools) as well as formal and informal leaders and residents within the community (former meth addicts, pharmacists, concerned citizens, a treatment professional). The process of community mobilization is grounded in local concerns and energy and works to empower local ownership in support of greater sustainability and impact.

#### **IV. References**