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THE RELATIONSHIP BETWEEN STATE METHAMPHETAMINE PRECURSOR LAWS AND TRENDS IN SMALL TOXIC LAB (STL) SEIZURES

Duane C. McBride, Yvonne M. Terry-McElrath, Jamie F. Chriqui, Jean C. O'Connor, Curtis J. VanderWaal

INTRODUCTION AND PURPOSE

While the consumption of methamphetamine in the general United States (US) population appears to have been fairly stable over the last decade (Johnston, et al., 2007; National Survey on Drug Use and Health, 2005), there is considerable evidence that there has been an increase in the use of methamphetamine in at-risk populations. Reports from the Drug Abuse Warning Network (DAWN) indicate a major increase in amphetamine/methamphetamine related emergency room (ER) visits occurring around the year 2000. In the mid-1990s, amphetamine/methamphetamine was mentioned in about 25,000 ER visits per year. In 2000, the number of ER visits mentioning amphetamine/methamphetamine reached 30,000 (DAWN, 2004), and increased steadily thereafter each year reaching 138,950 mentions, or approximately 10 percent of all ER visits, in 2005 (DAWN, 2005; 2007). Substance abuse treatment admissions with methamphetamine as the primary drug for those 12 and over have also increased significantly over the last decade. In 1993, the rate of treatment admissions documented in the Treatment Episode Data Set (TEDS) with methamphetamine/amphetamine as the primary drug of abuse was 13 per 100,000 population involving 28,000 admissions or 2 percent of all admissions. By 2003, this had increased to 56 per 100,000 population involving 136,000 admissions or 4 percent of all admissions (Substance Abuse and Mental Health Services Administration (SAMHSA), 2006). TEDS data also document the movement of admissions from Western States to Midwestern and Southern states over the 10 year time period with Northeastern states still having rates similar to 1993 levels (SAMHSA, 2006).

A key factor in the observed increases in methamphetamine-related ER appearances and treatment admissions is believed to be the spread of small toxic lab production of methamphetamine and a corresponding increase in local availability of the substance (Bundy, 2004; Colby, 2004; Rutledge, 2004; Wright, 2004). Small toxic labs (STLs) are generally defined as laboratories that produce one pound or less of methamphetamine per cooking cycle, and were estimated to provide approximately 20 percent of the US methamphetamine supply in 2006 (O'Connor et al., 2006). So-called super labs (located in the U.S., Mexico, and Southeast Asia) capable of producing 10 pounds or more of methamphetamine per cooking cycle, provide the remainder of the US supply.

Data from the Drug Enforcement Agency's national Clandestine Laboratory Seizure System (CLSS) documents a large increase in the number of US STLs in the early 2000s with a movement of labs from West to East. The CLSS reported 6,777 methamphetamine STL seizures in 1999, increasing to 8,577 in 2001 and 10,015 in 2004 (National Drug Intelligence Center, 2005; 2006). Increased STL seizures and associated consequences (to be described in the next Section) stimulated significant legislative activity at the state level where policy makers attempted to reduce domestic methamphetamine production by severely restricting access to the precursor chemicals used in STL methamphetamine production (O'Connor et al., 2006). In 2005, the Federal government became more directly involved with the issue by passing The Combat Methamphetamine Epidemic Act or CMEA (CMEA, 2006). This act provided a nation-wide approach to controlling access to precursor chemicals while not preempting more stringent state laws (O'Connor et al., 2006).

Recent reports indicate that there has been a significant decrease in the number of STL seizures since the enactment of precursor laws (Office of National Drug Control Policy, 2006). It

is estimated that only about 2,159 STLs were seized in 2006 (National Drug Intelligence Center, 2006). While official data and anecdotal reports suggest that state policy changes played a key role in the observed decrease in STL methamphetamine production, there has not been a multi-state scientific analysis of the elements of states' enacted legislation or adopted regulations (hereafter referred to as state policies) restricting access to methamphetamine precursors that correspond with STL seizure decreases. In order to provide such an analysis, the authors conducted a research project with three objectives: (1) document state methamphetamine precursor laws/regulations in effect as of October 1, 2005; (2) examine the perceptions of key informants in five states (including law enforcement personnel, pharmacists, and health/human service workers) of the impact of precursor laws on STL production of methamphetamine; and (3) examine the relationships between state methamphetamine precursor policies and trends in STL seizures after the implementation of such policies. The first objective was addressed in a 2007 report by O'Connor et al., 2007). The second objective is being addressed in a separate analysis. The third objective will be addressed in this paper. Specifically, this paper will (1) examine the differences *within* states pre and post methamphetamine precursor law implementation focusing on ephedrine and pseudoephedrine in terms of trends in STL seizures related to specific state policies, and (2) examine the differences *between* states in terms of trends in STL seizures related to state policy variance regarding the precursor restrictions. Ephedrine and pseudoephedrine were emphasized because they are the most common precursor chemicals available in over the counter health care products and there was a broad consistent focus on these two precursor chemicals in the state policies. Further, law enforcement efforts have identified these chemicals as the primary substances found at small toxic laboratory sites (Amera-Chem, Inc., 2004). State laws have addressed a variety of other chemicals and reagents that are used at

STLs to produce methamphetamine (O'Connor et al., 2007); however, anecdotal evidence indicated that ephedrine and pseudoephedrine were the key ingredients (Bundy, 2004; Colby, 2004; Rutledge, 2004; Wright, 2004). A discussion of the other chemicals and reagents addressed in the state laws is provided elsewhere (see O'Connor et al., 2007).

BACKGROUND

THE COSTS OF METHAMPHETAMINE

Methamphetamine was first synthesized in Germany in 1887 and produced in Japan early in the twentieth century. It was used to alleviate fatigue and increase alertness. Additional medical uses have included the treatment of narcolepsy and asthma as well as obesity (McGuinness, 2006). Methamphetamine has also reportedly been used to decrease the fatigue of military personnel and permit the sustained performance of long-term, complex military missions, at times with disastrous effects on judgment (Kenagy et al, 2004). By the 1950s, it was being used to enhance sustained work performance in occupations such as long-distance truck driving; it also was being used for weight loss (for a history of methamphetamine, see Anglin et al., 2000).

Pharmacologically, methamphetamine is classified as a stimulant with hallucinogenic effects. The substance can be produced in a variety of forms including powder, crystal, and tablets, and can be smoked, taken orally in pill form, or dissolved for injection (National Institute on Drug Abuse (NIDA), 2006). Methamphetamine is a derivative of amphetamine, but appears to have a stronger impact on the central nervous system. Mechanisms of action include stimulation of the central nervous system resulting in increased heart rate and blood pressure as

well as hyper physical activity (NIDA, 2006). Other specific effects include the release of dopamine (NIDA, 2006), inhibition of the reuptake of dopamine (Baucum et al., 2004) and the loss of dopamine transporters (Volkow et al., 2001). This pharmacological manipulation of the brain's reward system results in a high level of abuse and addiction potential. It may also be important to note that methamphetamine differs from cocaine--another commonly abused stimulant--in some crucial ways, including having an average half life in the human body of about twelve hours compared to one hour for cocaine (NIDA, 2006).

Methamphetamine use has resulted in significant public safety consequences. Relationships between drug use and public safety have been a primary focus of criminologists for a number of decades. Summary articles have argued that drug use is related to crime in a number of specific ways, including (1) increased criminal behavior, (2) sustained criminal behavior, (3) criminal behavior focused on specific types of crime, and (4) violent behavior based on the psychopharmacological effects and/or drug markets (Hansell, 2006; McBride and McCoy, 1993; McBride et al., 2003). The psychopharmacological properties of methamphetamine may be core to understanding the relationship between methamphetamine use and criminal behavior. As has been noted, methamphetamine is metabolized more slowly than other commonly used stimulants such as cocaine. Anglin and his colleagues (2000) reported that methamphetamine users reported a sustained euphoric state for up to eight hours. This sustained psychopharmacological effect has been thought to relate to significant criminal behavioral consequences resulting from increased, sustained and violent criminal behavior.

Sommers and associates (2006) found that methamphetamine use appeared to increase the risk of violent behavior among methamphetamine users. A recent article by Cartier and his colleagues (2006) focused on the criminal behavior of methamphetamine users who had been

paroled in California. They found that, compared to other types of drug users, methamphetamine users were significantly more likely to self-report high rates of violent behavior.

Methamphetamine users may also be more likely to sustain criminal behavior. Cartier et al. (2006) found that those who used methamphetamine were significantly more likely to be re-incarcerated for any type of crime or parole violation. Further, studies undertaken by the National Association of Counties found that the majority of the counties surveyed reported that methamphetamine was their major drug problem with over sixty percent of these counties reporting that methamphetamine users accounted for increases in burglaries, robberies and domestic violence (Hansell, 2006; Kyle and Hansell, 2005).

The use of methamphetamine may also relate to other specific types of crime. Given that the production of methamphetamine can be easily accomplished by the use of commonly available precursors, it may be expected that methamphetamine is related to the theft of these chemicals (Cretzmeyer et al., 2003). There are also reports in the substance abuse and national media that methamphetamine use is related to identity theft. The reports suggest that methamphetamine users engage in identity theft as a means of obtaining desired goods and services as well as providing multiple identities to purchase precursor chemicals needed to produce methamphetamine (*Alcoholism and Drug Abuse Weekly*, 2004; 2005; Leland, 2006).

In examining the relationship between drug use and violence, researchers have argued that an important part of understanding the relationship between drug use and violence is understanding the role of drug markets including production. Drug markets are often unstable in location and “ownership”. While the relationship is very complex, this instability often results in high rates of violence, especially in African-American communities (Ousey and Lee, 2004). There is some initial evidence that methamphetamine distribution may be related to violence.

Cretzmeyer and colleagues (2003) found that increased trafficking in methamphetamine in communities was related to increased violence in those communities. Of particular interest to this project is the relationship between the production of methamphetamine and crime and violence associated with the production of methamphetamine in STLs. As previously noted, there may be an association between the pharmacological effects, drug distribution markets and violence. STLs may also have a relationship to crime and violence; within a home based STL that can also directly relate to child abuse and domestic violence (Cohen et al., 2003). Reports have also indicated that explosives are often planted around STLs to protect the production unit and violence is likely to be directed at law enforcement personnel who seize the lab (Scott and Dedel, 2006).

In addition to the above-noted direct relationship between crime and methamphetamine use/production, the production of methamphetamine in STLs has major consequences for community safety and health. A wide variety of research has found that chronic methamphetamine use by parents is related to high rates of child neglect and abuse (Mecham and Melini, 2002; Dube et al., 2003) as well as homelessness and removal of children from their homes by the social welfare system (Kyle and Hansell, 2005). This, in turn, relates to behavioral and learning problems among the children of methamphetamine users (Dube et al., 2003; Semidei et al., 2001). Given that STL methamphetamine production often occurs in a home environment, there are significant consequences related to direct exposure to toxic chemicals and related fumes. Exposure can result in chemical burns and damage to the respiratory system as well as a wide variety of neurological and other health-related consequences for those who live in the environment, particularly children (Barr et al., 2006; Farst et al., 2007). First responders (law enforcement, firefighters, emergency medical personnel, etc.) who participate in an STL

seizure or respond to an explosion or fire at a lab are also at high risk from the toxic compounds used in and resulting from methamphetamine production (Cooper et al., 2000; McFadden et al., 2006). Further, there are continuing health consequences from contamination of the broader environment including soil, ground water, and any other material in or near the production site. Environmental contamination can result in long-term, on-going health consequences for those who come into contact with the contaminated environment and considerable local costs related to necessary clean-up efforts (Royal Canadian Mounted Police Criminal Intelligence Directorate and Drug Enforcement Administration Intelligence Division, 2001).

In a broad examination of the consequences of methamphetamine use and STL production, it is also important to note that major health consequences have been associated with the use and abuse of methamphetamine. These have included hyperthermia, convulsions, brain aneurisms, strokes, arrhythmia, severe dental problems, and--after prolonged use--collapse of the cardio-vascular system (Anglin et al., 2000). Methamphetamine has been associated with significant cognitive impairment involving memory, learning new skills, information processing, information and learning retention and psychomotor speed (Craig et al., 2005). Use of methamphetamine during pregnancy has been found to be associated with a variety of fetal development problems that may impair brain structure development and have consequences for attention problems, learning, memory, and visual motor integration (Chang et al., 2004; Czretzmeyer et al., 2003; Davies and Bledsoe, 2005). Methamphetamine has also been shown to relate to HIV risks in at least two ways. There is a well-documented relationship between methamphetamine use and high-risk sexual activity such as multiple sex partners and not using condoms, likely resulting in higher rates of HIV infection (Hirshfield et al., 2004; Krawczyk et al., 2006; Kurtz, 2005; Whittington et al., 2002). Research by Nair and associates (2006) also

suggests that methamphetamine may also have an effect on the human immune system that increases the probability not only of infection but more rapid disease progression.

In summary, the existing literature suggests that methamphetamine use relates to high risks of addiction and abuse, health risks, sustained and increased general and violent criminal behavior, and increased risk of child neglect and abuse. Further, STL production of methamphetamine results in considerable safety risks to law enforcement, first responders and the general community; and major health problems for the who use, produce or are in the environment of methamphetamine production. Given the increase in the widespread geographical distribution of STLs and the associated consequences of domestic methamphetamine production and the use of methamphetamines, states and the Federal Government have undertaken major efforts to restrict access to over the counter medications and other products that contain chemical precursors. As has been documented (O'Connor et al., 2006) states took a variety of approaches to restricting access. This variance provides the opportunity to examine the relationship between state policies specifically directed toward the reduction in the domestic production of methamphetamine and trends in the seizure of STLs.

STATE POLICY RESPONSES TO THE METHAMPHETAMINE STL PROBLEM

State policy response to the methamphetamine STL problem (specifically the methamphetamine precursor problem) focused on seven key areas: (1) scheduling of essential precursors under the state's controlled substances act, (2) restrictions on the quantity of the essential precursors and other precursors sold per retail transactions, (3) restrictions on the precursor sales environment, (4) limits on the precursors that can be possessed, (5) penalties for the purchase or possession of precursors, (6) regulatory agencies or bodies charged with

precursor regulation, and (7) preemption of local ordinances. (See O'Connor et al., 2007, for an in-depth discussion of each of these types of policy provisions.) With the exception of regulations governing the sale of non-ephedrine or -pseudoephedrine precursor chemicals and reagents (e.g., red and white phosphorous, anhydrous ammonia, iodine, etc.) and scheduling restrictions on ephedrine, the majority of the state precursor restrictions in effect in October 2005 were enacted in 2001 or later (O'Connor et al., 2007).

While the authors present a detailed discussion of the nature and extent of the state restrictions in O'Connor et al., 2007, the following briefly highlights the primary findings from that study (unless otherwise noted, all citations for the remainder of this section taken from O'Connor et al., 2007). Much of the state policy emphasis regarding precursor controls has focused on restrictions on the purchase and possession of ephedrine and pseudoephedrine. As of October 1, 2005, twenty-nine states restricted the quantity of pseudoephedrine that could be purchased at retail, while 22 states restricted the quantity of ephedrine that could be purchased at retail. The quantity restrictions reflected combinations of limits on the total weight of the precursor chemical or the number of packages containing the chemical that could be purchased at one time. The pseudoephedrine package limits ranged from 1 to 3 packages, with 17 states imposing time limits on the sales restrictions that ranged from no more than 1 package (1.4 grams of pseudoephedrine base) per day to no more than 9 grams in 30 days. The ephedrine quantity restrictions were similar; ranging from 2 to 3 package limits and with 12 states specifying time constraints on the sales of not more than 3 grams in 7 days to not more than 9 grams in 30 days. A combination of fine and imprisonment penalties associated with violations of the retail sales transaction limits applied to both buyers and sellers, with the penalties assigned to sellers much more prevalent than those assigned to buyers.

At the same time, more than half of the states' laws (28 states) included at least one measure to prevent or deter the theft or diversion of pseudoephedrine in the retail sales environment; 22 states imposed such restrictions on ephedrine. Chief among these restrictions were requirements that: (1) the seller require the buyer to produce a government-issued photo identification (21 states pseudoephedrine, 18 states ephedrine); (2) products be placed behind the counter (19 states pseudoephedrine, 14 states ephedrine); and (3) buyers sign a purchase log (17 states pseudoephedrine, 15 states ephedrine). Other retail sales restrictions, albeit somewhat less common, included requirements that the products be locked or under video surveillance.

Other state restrictions included possession limits on the quantity of pseudoephedrine and ephedrine that could be possessed. As of October 1, 2005, possession of ephedrine and pseudoephedrine was a felony in 29 and 31 states, respectively, with an additional 3 states assigning a misdemeanor offense to possession of either ephedrine or pseudoephedrine. Possession quantity limits were imposed on each product by 37 states. As with the retail transaction limits, possession penalties included both fines and imprisonment, with more states specifying imprisonment penalties (37 states) than fines (33 states).

As with other public policy arenas, the precursor chemical restrictions are not self-enforcing. Hence, the inclusion of a statewide authority responsible for enforcing the individual state laws was often specified. Interestingly, as of October 1, 2005, only 21 states identified a state agency or regulatory body to enforce the laws, with some designating more than one such entity. Most of these states identified a pharmacy-related agency (15 states) or a law enforcement-related agency (13 states).

The three other foci within the state laws related to (1) controlled substance scheduling, (2) restrictions on other precursor chemicals and reagents, and (3) state preemption of local

methamphetamine precursor controls. Although the Federal government controls drugs according to five schedules based on their potential for abuse under the Controlled Substances Act or CSA (CSA, 1970), states have developed their own scheduling guidelines that are used in sentencing decisions for drug offenders tried in state courts (Chriqui et al., 2002). With regards to the scheduling of ephedrine and pseudoephedrine, the majority of states did not schedule either product as of October 1, 2005. Nineteen states scheduled pseudoephedrine as either Schedule II (3 states), III (3 states), IV (6 states), or V (7 states). Twelve states scheduled ephedrine as either Schedule II or III (2 states each) or V (8 states). At the same time, nearly three-quarters of the states (38) restricted the sale or possession of at least one other methamphetamine-related precursor chemical or reagent, with phenyl-2-propanone and phenylacetone being the most commonly restricted chemicals (27 states each) and anhydrous ammonia being the most commonly restricted reagent (25 states) followed by iodine and red phosphorous (19 states each). Finally, in two-thirds of the states, preemption of local laws was not addressed. Two states completely preempted local precursor restrictions as of October 1, 2005, and an additional 15 states partially (but not entirely) preempted such restrictions.

METHODS

DATA SOURCES

Two main data sources were used in these analyses: (1) state policies, including effective dates, related to methamphetamine precursor control laws and regulations in effect as of October 1, 2005; and (2) methamphetamine-related STL seizure data.

State Policy Data

State methamphetamine precursor policies in effect as of October 1, 2005, for both ephedrine and pseudoephedrine were obtained by The MayaTech Corporation from Westlaw and state government websites, as necessary, using primary legal research methods (Mersky & Dunn, 2002). As noted earlier, the state policies included state statutory and administrative laws. A detailed description of the state policy data, including data collection methodology, can be found in O'Connor et al. (2007). State-specific effective dates for all policies were also obtained as part of the data collection process. In other words, although the policy data reflected laws in effect as of October 1, 2005, individual policy provisions often had specific effective dates at which time the provisions became effective (see Appendix A for state citations and effective dates). The provision-level effective dates enabled the pre-/post- policy analyses described below.

STL Seizure Data

Methamphetamine-related seizure data for all states from 2004-2006 were obtained from the Clandestine Laboratory Seizure System (CLSS) housed at the El Paso Intelligence Center (EPIC). CLSS data include clandestine laboratories seized in the United States by local, state and Federal law enforcement agencies. CLSS data are based on a voluntary reporting system, and include only those seizures reported to EPIC by contributing agencies. Thus, reported seizures may not fully reflect total seizures nationwide. However, as will be discussed below, a number of steps were taken to ensure, as far as possible, the use of reliable data. Data were obtained at the incident level and contained state identifiers, as well as data on seizure type (laboratory, dumpsite, chemical/glassware seizure), date, lab capacity, and lab type (anhydrous ammonia, tablet extraction, methamphetamine etc.).

DATA PREPARATION

Working with EPIC personnel, a series of steps were used to organize the CLSS data for analysis. First, ten states were excluded either due to known problems with data reporting or low seizure frequency due to regional location as in New England where the methamphetamine STL problem does not appear to have yet significantly developed (CT, DE, MA, MD, ME, NH, NJ, RI, TX, VT). Second, a comparison of CLSS data with Community Oriented Policing Services (COPS) data was employed in order to evaluate CLSS data reporting quality. COPS data includes counts of the number of times toxic site clean-up funds from COPS are requested by state. For calendar year 2006, the count of COPS requests per state was compared with the number of seizures reported in the CLSS data. As not every lab seizure would be expected to require clean-up funding, the number of CLSS seizures should approximately meet or exceed the number of COPS clean-up requests per state (the following states do not primarily rely on COPS data for clean-up, or use COPS grants, and thus were not compared: CA, HI, KS, KY, MD, MO, ND, WA). A minimum threshold of 75% agreement was used, and resulted in exclusion of an additional eight states (AK, LA, MN, NM, SC, TN, UT, WV). Thus, a total of 32 states were retained for analysis. Overall, it was concluded that data from these states would be the most reliable for comparison of state methamphetamine precursor laws and trends in STL seizures.

CLSS data were further organized by lab capacity and lab type. Seizures of labs with production capacity of 10 pounds per cooking cycle or higher (termed “super labs”) were removed (Amera-Chem, Inc., 2004; O’Connor et al., 2006). Data were then carefully organized by lab type to ensure that only methamphetamine-related lab seizures were included (lab types that indicated methamphetamine-related activity and thus were retained included anhydrous

ammonia, hydriodic acid, ice conversion, methamphetamine, methcathinone (included as it requires the same ephedrine/pseudoephedrine precursors as methamphetamine), P2P/methylamine, tablet extraction, and urine extraction) (Amera-Chem, Inc., 2004). A total of 39,923 seizure incidents in the 32 states remained for analysis.

At this point, the coded state precursor policy data were merged with the incident-level CLSS data. A series of five indicator variables were created to identify if seizures occurred at various times following policy effective dates: within 30 days, 90 days, 180 days, 270 days, or any point following an effective date. The decision to create a series of variables reflecting post-law enactment was predicated on the anecdotal evidence indicating an immediate impact of the state laws on reductions in lab seizures (Bundy, 2004; Colby, 2004; Rutledge, 2004; Wright, 2004) as well as evidence from the relationship between other types of drug and substance control policies and behavior change that indicated both immediate and intermediate (3-years or less) impacts on behavior change (Fuller et al., 2006; Levy, 2007). Given the variance in enactment and effective dates for the state laws in this area (see Appendix A), the “any” lag variable was created to reflect “any” date after a given state’s law took effect to account for the potential immediate/short term association between the laws and reported lab seizure changes as well as the relationship between the laws and longer time spans (particularly in the early “initiator” states whose laws had been on the books for a few years at the time of this analysis).

Data were then aggregated into bi-monthly counts of seizures per state, resulting in an N of 2,010. Cases were not retained for a specific bi-monthly period for a state if no seizures were reported. The maximum number of cases per state was equal to 72 (3 years x 24 bi-monthly periods per year). The minimum number of cases per state in the resulting dataset was 24, with a

mean of 62.8. Cases were coded as positive for any specific policy if at least 50 percent of the seizures in any by-monthly time period were coded for a specific time lag indicator variable.

CONSTRUCTS AND MEASURES

Outcome Measure

For all analyses, the outcome measure was based on the bi-monthly count of seizures per state (as described above). Given the strong positive skew of the measure, analytical models utilized the natural log transformation of the original variable.

Independent Measures

State Policies. As noted previously, five lag variables were created for state policies in each of the following state policy dimensions: (1) precursor scheduling under the state's controlled substances act, (2) retail transaction quantity restrictions (3) sales environment restrictions (specification of product location/ID required, etc.), (4) possession quantity limits, (5) purchase and possession penalties for precursor law violations, (6) agency (if any) responsible for enforcing precursor policy laws/regulations, and (7) state preemption of local ordinances. Initial analyses were conducted to investigate which lag formation appeared to best relate to the outcome of bi-monthly STL seizure counts. Results indicated that both the 180-day and "any" lag appeared to show the strongest relationships across policy dimensions. Given the limited number of years of data in the analyses, it was decided to use the "any" lag in order to retain the largest sample sizes in models. The initial models indicated that four of the above

seven policy areas were most likely to relate to seizure counts: (1) retail transaction quantity restrictions, (2) sales environment restrictions, (3) purchase and possession penalties, and (4) agency responsible for enforcing precursor policy laws/regulations. As was discussed in the introduction to this paper, a key part of the overall research project was conducting key informant interviews in five states that focused on the perceptions of law enforcement personnel, pharmacists, and health and human service professionals regarding the impact of methamphetamine precursor laws. The four indicated policy areas were also suggested by key informants as the essential components perceived to affect the impact of state laws on the presence of STLs.

Individual policies within each of the four areas noted above were then explored for evidence of relationships with seizure counts. Importantly, results indicated that states appeared to enact bundled policy provisions; for example, if a state enacted a policy requiring proof of ID when purchasing either ephedrine or pseudoephedrine, it was also likely to require that such precursors be available only behind the counter. After examining colinearity and model fit statistics, the following state policy variables were created for further analyses:

1. Clerk intervention and quantity/packaging restrictions for both ephedrine and pseudoephedrine: Clerk intervention defined as at least one of the following: behind counter, signature required, ID required, sales to minors prohibited. Quantity/packaging restrictions defined as “any” restrictions. These variables were combined to form one four-level ordinal measure: 0=neither clerk intervention nor quantity/packaging restrictions; 1=no clerk intervention, but do have quantity/packaging restrictions; 2=have clerk intervention, but no quantity/packaging restrictions; 3=have both clerk intervention and quantity/packaging restrictions.

2. Buyer purchase offense severity for both ephedrine and pseudoephedrine: 0=non-crime, 1=crime (misdemeanor or felony).
3. Specification of sales regulatory/enforcement agency: 0=no such specification; 1=agency specified.

Federal Policies. O'Connor et al. (2006) clearly point out that policy activity directed at limiting access to methamphetamine precursor chemicals has not been limited to the state level. While a variety of historical Federal policies have been in place, two such policies became effective during the 2004-2006 time period that could be expected to relate directly to STL seizure rates in the current models. These policies were both included in the Combat Methamphetamine Epidemic Act of 2006 (see Appendix A for citation information and effective dates):

1. Purchase quantity limits: 0=prior to policy; 1=restrictions for non-liquid pseudoephedrine sold to individuals.
2. Clerk intervention: 0=prior to policy; 1=requirements to place methamphetamine precursor products behind the counter or in locked cabinets at the point of sale, picture ID, retailer logbook of all sales, and staff training.

It is important to note that Federal law did not preempt more restrictive state policies. However, in recognition of the possible impact of Federal laws on the relationship between state methamphetamine precursor laws/regulations and STL seizures, analytical models included both Federal laws (based on their effective dates) identified above.

ANALYTICAL MODELS

In order to address the two main research questions, two types of analyses were undertaken: (1) analyses examining differences *within* states on the changes in the number of STL seizures over time by specific precursor policies, and (2) analyses examining differences *between* states associated with the various precursor policies (for an example of such an approach, see O'Malley and Wagenaar, 1991).

Analyses examining differences in STL seizures *within* states sought to examine pre- and post-policy implementation changes in STL seizure rates. It was hypothesized that there would be a significant decrease in seizures following policy implementation. For these analyses, state policy-specific models were run including only those states that implemented methamphetamine precursor policy changes. That is, these analyses included only states that implemented specific laws/regulations focusing on controlling access to methamphetamine precursors over the time period of the analysis. Thus, in this before-after analysis, each state acted as its own control in all models.

Analyses examining differences *between* states associated with the various precursor policies sought to investigate which policies (both state and Federal) appeared to be related to overall STL seizure rates once other policies were controlled for. Specifically, all states were included regardless of policy change status, with the models controlling for the *a priori* highly significant differences in STL seizure rates between states. Thus, results reflected the comparative strength of the different policies on between-state STL seizure rates.

Both types of analyses were conducted using SAS 9.2 specifying PROC GENMOD with a normal distribution and identity link. Federal policies were included in all within and between state analyses. All analyses were clustered by state, and included state dummy variables in order

to control for state-specific environmental variables not directly measured. Secular trends were accounted for by using year dummies.

RESULTS

POLICY ENVIRONMENT DESCRIPTION

As noted previously, a total of 2,010 cases representing bi-monthly seizure counts for 32 states were retained for analyses. Table 1 indicates that over the 2004-2006 period of study, the mean number of seizures per bi-monthly time period was 20, with a range of 1 to 213. However, as indicated in Figure 1, mean seizures dramatically decreased over time (26 per bi-monthly time period in 2004; 20 in 2005; 13 in 2006). Figure 2 presents trends in seizures over time by seizure type. Full operational lab seizures outnumbered dumpsite or chemical/glassware seizures almost 2:1 in 2004. By 2006, however, such marked differences had attenuated (although operational lab seizures still predominated).

[Table 1 about here]

[Figures 1 and 2 about here]

Table 1 also presents the overall distribution of cases by precursor policy. These data provide a context of understanding the proportional distribution of all cases (each case being one bi-monthly count of seizures per state) within the distribution of policy elements that were used in multivariate analyses. Over half of all cases occurred when the state had neither clerk intervention nor quantity/packaging restrictions for either ephedrine (64%) or pseudoephedrine (56%). Just over 10% of cases occurred in a policy environment where quantity/packaging restrictions were in place without clerk intervention (12% for ephedrine, and 13% for

pseudoephedrine), and 5% or less of cases occurred in policy environments where clerk intervention was in place, but not quantity/packaging restrictions (5% for ephedrine; 4% for pseudoephedrine). A higher percentage of cases occurred in policy environments where both clerk intervention and quantity/packaging restrictions were in place for pseudoephedrine (27%) than for ephedrine (19%). Approximately 23% of cases occurred in policy environments where the penalty for purchasing either ephedrine or pseudoephedrine was classified as a crime (either misdemeanor or felony). Finally, just over 30% of cases occurred where states had specified an agency for regulatory/enforcement activities regarding methamphetamine precursor sales. Regarding Federal policy, 21% of cases occurred following the effective date of purchase quantity limits on non-liquid pseudoephedrine sold to individuals, and 7% occurred following the effective date of clerk intervention policy.

WITHIN-STATE PRE- AND POST-POLICY STL SEIZURE RATE CHANGES

Federal Policy and STL Seizure Rate Changes.

In order to examine the potential effect of the two Federal policies included in analyses, states were stratified by state precursor activity during 2004-2006. A total of seven states had none of the state precursor policies investigated in this paper: Idaho, Michigan, Nevada, New York, Ohio, Pennsylvania, and Virginia. Two additional states (Arkansas and California) did have precursor laws, but exhibited no changes during the time period under study. The remaining 23 states all experienced some degree of precursor policy change during 2004-2006. Figure 3 shows the results of STL seizure trends for the seven states without any precursor policies, while Figure 4 shows similar data for the 23 states with policy activity; arrows indicate the effective

dates for both of the Federal policies of interest. Clearly, states without the methamphetamine precursor policies studied were not experiencing high levels of STL seizure activity, while states that implemented policy changes were grappling with much higher levels of seizure activity.

[Figures 3 and 4 about here]

To look for evidence of post-Federal policy change decreases in STL seizure rates, analyses were conducted with (a) the seven states without any of the studied state precursor laws, and (b) the two states with state laws but no changes in such laws. Analyses controlled for secular trends, and results are presented in Table 2. As noted previously, the distribution of bi-monthly counts of seizures per state exhibited a strong positive skew, and thus was transformed using the natural log. In all following tables, regression estimates and p-values are reported from models using the transformed outcome; however, tables report the non-transformed original means of seizures per policy category.

In the seven states without any of the studied state precursor policies, mean STL seizures did decrease significantly following the implementation of Federal purchase quantity limits on non-liquid pseudoephedrine. However, no significant reductions were observed following enactment of Federal policy on clerk intervention. In Arkansas and California, significant decreases in STL seizures were observed following the implementation of both Federal policies.

[Table 2 about here]

State Clerk Intervention and Quantity/Packaging Limit Policy and STL Seizure Rate Changes

Tables 3A and 3B present results of analyses examining STL seizure rates by state policy focusing on clerk intervention and quantity packaging limits (controlling for Federal policy). A total of 22 states had changes in this policy for ephedrine and/or pseudoephedrine during 2004-

2006, with the exact nature of the policy change differing between groups of states. Significant reductions in STL seizures were observed following state policy changes in the purchasing environment for both precursor chemicals. Additionally, results indicated that Federal policies were also independently associated with reductions in STL seizure rates.

[Tables 3A and 3B about here]

State Purchase Severity Policy and STL Seizure Rate Changes

Table 4 presents results of STL seizure rate changes for those states that changed policy on either ephedrine or pseudoephedrine purchase penalty severity. A total of nine states had a change in this policy (seven changed for both ephedrine and pseudoephedrine). STL seizure rates showed significant decreases following the implementation of state policies making the violation of precursor laws/regulations a crime. Federal policy again remained independently associated with seizure decreases.

[Table 4 about here]

State Regulatory/Enforcement Agency Policy and STL Seizure Rate Changes

Table 5 presents the results of STL seizure rate changes for the 11 states that implemented a change in regulatory/enforcement agency policy during 2004-2006. STL seizure rates again showed a significant decrease in these states following specification of an agency with the authority to enforce precursor sales laws. As observed previously, Federal policy again remained independently significant, as well.

[Table 5 about here]

BETWEEN-STATE DIFFERENCES IN STL SEIZURE RATES BY POLICY

ENVIRONMENT

The results of the analyses presented clearly indicate that statistically significant reductions in STL seizures occurred following the implementation of specific policies directed at controlling access to two of the most common methamphetamine precursor chemicals. However, those models could not compare state-wide STL seizure rates by various policies simultaneously given that only states with a change in any particular policy were included. Out of the 32 states retained for analysis in this paper, only 2 had both ephedrine-specific policies (clerk intervention and quantity/packaging restrictions, and purchase penalty severity) and a policy on state regulatory/enforcement agency specification. Only 3 had both of the pseudoephedrine policies as well as state regulatory/enforcement agency specification. Thus, inclusion of all policies in one model when examining within-state pre- and post-policy change was problematic due to the limitations on the number of states available for inclusion and the resulting colinearity between policies. However, if the research question focused on between-state differences in STL seizure rates by overall policy environment; all states could be included regardless of policy change status, with the models controlling for the *a priori* highly significant differences in STL seizure rates between states. Results of these analyses are presented in Tables 6A and 6B for ephedrine and pseudoephedrine, respectively. Policies were first entered individually in Models 1-3, and then jointly in Model 4. Discussion will focus on Model 4, as this model shows which policies remain significant in predicting STL seizure rates between states in a multivariate context.

[Tables 6A and 6B about here]

Ephedrine Policy Models

States with policies on ephedrine quantity/packaging restrictions showed significantly lower seizure rates than did states without either ephedrine clerk intervention or quantity/packaging restrictions; however, no significant differences for the other levels of the clerk intervention and quantity/packaging restriction variable remained significant in the multivariate model. Further, no difference in seizure levels between states was observed based on whether or not violations of the state precursor laws were defined as a crime by the state. STL seizure levels were lower in states that specified an agency for regulatory/enforcement responsibilities. In these models, both implemented Federal policies (purchase quantity limits and clerk interventions at the point-of-sale) were also still independently related to decreased STL seizures.

Pseudoephedrine Policy Models

Between-state relationships for STL seizure rates and clerk intervention and quantity/packaging restrictions were generally stronger for pseudoephedrine policy than for ephedrine policy. States with policies on pseudoephedrine quantity/packaging restrictions showed a greater decrease in the number of STL seizures than did states without either pseudoephedrine clerk intervention or quantity/packaging restrictions. States with both clerk intervention and quantity/packaging restrictions also showed lower seizure rates. As with ephedrine, no difference in seizure levels between states was observed based on whether or not the state had criminal penalties for violations of precursor laws/regulations. Further, after controlling for pseudoephedrine clerk intervention and quantity/packaging restrictions, STL seizure levels were not significantly lower in states that specified an agency for

regulatory/enforcement responsibilities. Federal policy implementation continued to be related to decreased STL seizures.

DISCUSSION

Before discussing the findings, it is important to understand the limitations of the analyses. The source for the outcome measure for these analyses is the CLSS data which, as noted previously, are comprised of voluntarily reported data. Given the voluntary nature of the reporting system, CLSS data are not necessarily reported with equal accuracy across states or within states across time. However, the CLSS data remain the only extant source of data on illicit drug laboratory seizures in the US, and are a primary source of information for the US Department of Justice (e.g., National Drug Intelligence Center, 2005). Given that the authors worked closely with EPIC personnel and COPS comparisons to include only those states with the highest data quality, the resulting data is believed to be the best currently available. Readers should also recognize that the analyses reported focus only on how the examined policies relate to STL seizure reductions. Analyses examining how such policies relate to methamphetamine use, or to reductions in costs born by local, state, and Federal governments resulting from STL clean-up efforts and/or hospital and treatment costs, were not within the scope of this project.

In the last few decades, there has been considerable discussion regarding the specific roles of Federal and state governments in establishing drug policy. While many may perceive that drug policy is exclusively a national affair, research has documented that states have widely varying substance-related policies with significant differences in areas such as drug scheduling, medical marijuana, needle exchange, and drug law violation penalty severity (see Chriqui et al., 2002; McBride et al., In Press(a); Terry-McElrath and McBride, 2004).

The data presented in the current paper additionally document that states take a wide variety of approaches toward reducing access to methamphetamine precursor chemicals. Over the three years included in the study, 69% (22) of the 32 retained states implemented some type of change in policy focusing on either (a) controlling the quantity of ephedrine/pseudoephedrine-containing product sales, or (b) the required form (if any) of clerk intervention at the point of purchase. Twenty-eight percent of retained states (9 states) changed policy on the definition of precursor law violation as a crime; and about one-third (11 states) made a change in specifying a regulatory agency to oversee enforcement of the states policy. Almost all of the state policy changes noted above occurred prior to changes in Federal policy specifying non-liquid pseudoephedrine quantity limits as well as defining methamphetamine precursor chemical clerk intervention policies. Such variance over time allowed comparisons between methamphetamine precursor policies and, to some extent, comment on the possible effectiveness of various policies relative to one of the most significant public-health concerns resulting from methamphetamine production and use: STLs.

Perhaps one of the most important points to note is that, overall, the analyses suggest that both state and Federal policies operate independently. That is, in almost all of the analytical models, Federal laws focusing on non-liquid pseudoephedrine quantity limits and requiring clerk intervention for the purchase of methamphetamine precursor chemicals significantly related to a reduction in STL seizures after controlling for state policy. In addition, many state policies significantly related to reductions in STL seizures after controlling for Federal policies. These data remind us of the importance of understanding the national policy context within which state polices operate, yet indicate that both Federal and state law are an important part of a

comprehensive approach directed at reducing the consequences and harms associated with illicit drug production and use.

In the process of analyzing the possible impact of Federal policies in states with no current state-level methamphetamine precursor chemical policy, it became clear that such policy was not a priority unless a state was experiencing a comparatively higher level of STL seizures. Stratifying states by recent activity in precursor laws showed that in states without precursor policy, STL seizure rates were very low and remained low during the time period of the study. In comparison, seizure rates were dramatically higher in those states that did experience policy change. At least in the current analyses, public health consequences preceded (and probably resulted in) legislative action, which was then found to relate to changes in the initial public health concerns. In those states that reported a high level of STL seizures, there was a fairly consistent decline in methamphetamine STL seizures soon after the implementation of state and Federal precursor policies. These findings are consistent with media reports (Associated Press, 2006) as well as conclusions by the U.S. Department of Justice (National Drug Intelligence Center, 2006).

Another unique contribution of the analyses reported in this paper involves the specific policies examined. As discussed in the introduction, there is literature that documents a decrease in STL seizures after the implementation of general policies. However, little research has focused on specific policy elements. In this report, within-state analyses found that states which restricted the quantity of ephedrine or pseudoephedrine sales, or required some form of clerk intervention, reported fewer STL seizures following policy implementation. In between-state analyses, quantity limits remained a significant predictor of lowered STL seizure rates after controlling for other precursor policies for both ephedrine and pseudoephedrine. For

pseudoephedrine, combining quantity restrictions with the requirement for some type of clerk intervention (requiring personal identification or locating the product behind the counter) also significantly related to reduced STL seizures after controlling for other precursor policies. This suggests that restricting precursor chemicals via quantity restrictions likely relates to less availability, which in turn relates to fewer attempts to manufacture methamphetamine in STLs. It also suggests that for pseudoephedrine--the substance with higher direct consumer access in the local retail environment--clerk intervention plays a key role in reducing access for STL manufacturers.

One of the more interesting policies examined in this report was whether or not states identified an agency that was responsible for enforcing/regulating enacted methamphetamine precursor policies. As was noted, only 11 of the 32 retained states implemented policies identifying a regulatory agency during 2004-2006. States that identified an agency to oversee the implementation of their methamphetamine precursor sales laws experienced significant reductions in STL seizures following the effective date of the policy in within-state models. In between-state analyses, this policy remained significantly related to decreased STL seizure rates in models containing ephedrine precursor policy, but not pseudoephedrine. The data may suggest that for substances with a longer history of policy implementation and a longer history of Federal control (like ephedrine; see O'Connor et al., 2006); it is not sufficient merely to pass laws and regulations that restrict access to dangerous chemicals; mechanisms for reporting violations and regulating compliance must also be in place. For substances which have only recently experienced significant restrictions, the relative impact of the regulatory/enforcement environment may not become apparent until after the initial implementation regulations and approaches are able to take effect.

One of the most common policies used in attempts to reduce the production, distribution or use of illegal drugs involves the enactment of severe criminal penalties. This approach is based on classic deterrence theory that argues that if penalties are sufficiently severe, the behavior will be less likely to occur (Mendes and McDonald, 2001). The data presented from within-state analyses indicated that states which defined the violation of methamphetamine precursor purchase laws as a crime (misdemeanor or felony) experienced significant declines in STL seizures following policy implementation. However, between-state analyses that controlled for the relative impact of various policies did not indicate that states with criminal penalties for purchase experienced reduced STL seizure rates compared to states without such policy. This may suggest that, at least in regards to STL seizures, penalty policies for purchase do not appear to be as crucial as are laws restricting and enforcing access limitations.

CONCLUSION

At the beginning of the discussion, it was noted that state policy variance provided an important opportunity to examine differences in implementation approaches to address the domestic production of methamphetamine in STLs. In observing the concerns expressed about this phenomenon in the media by both the general public and policy makers, Wermuth (2000) expressed concern that states and the Federal government would take a high deterrence approach and impose severe criminal penalties for the production and possession of methamphetamines and that such an approach would merely extend a “war on drugs” without addressing other approaches that may better address public health and safety issues. The analyses presented in this paper suggest that both the states and the Federal government took a measured and complex approach to reducing STL methamphetamine production. Models suggested that defining the

violation of methamphetamine precursor purchase laws as a crime may not be the most significant element of a policy approach. Purchase quantity controls combined with clerk intervention and having a regulatory agency consistently related to reductions in STL lab seizures in both within- and between-state analyses. These data suggest that there is not a simple approach to addressing an issue such as the domestic production of methamphetamine in STLs. However, a combination of policies appears to have related to significant reductions in the domestic STL production of methamphetamine. It remains to be seen if this reduction is related to a reduction the use of methamphetamine.

POLICY IMPLICATIONS

This is an era when states are attempting to deal with a wide variety of different social problems that occur within their borders. One of the major social problems communities and states are attempting to address through the development of effective policies is substance abuse. State substance-related policy efforts range from the use of deterrence to prevention and alternatives to incarceration to treatment quality standards to medicalization (Chriqui et al., 2002; 2007; McBride et al., In Press(a); Pacula et al., 2002). Research shows that states are often engaged in policy innovations as they attempt to address substance abuse and its consequences, and policy does often relate to drug use patterns and the types of treatment services offered (Chriqui et al., In Press; McBride, et al., In Press(b); Terry-McElrath, In Press). Data presented in this paper indicate that many states have developed policies that do, indeed, appear to relate to rapid and significant declines in the production of methamphetamine in STLs. Previously published testimony (Bundy, 2004; Colby, 2004; Rutledge, 2004; Wright, 2004) and data (Office of National Drug Control Policy, 2006) indicated that state implementation of precursor

chemical policies may have related to direct and quick declines in STL seizures. The data presented in the current paper analyzed direct seizure cases across multiple states, with results providing independent verification of such prior testimony and official reports.

The current findings strongly imply that both state and Federal policy matter. As was discussed, states have often taken the initiative in drug policy approaches and changes. As O'Connor and her colleagues noted (2006), when congress passed and the President signed the Combat Methamphetamine Epidemic Act on March 9, 2006, state policies were cited as providing the evidence for needed Federal legislation, as well as helping define the type of legislation that might be effective while not preempting more restrictive state policy. In the analysis presented above, both state and Federal policies were independently related to declines in STL seizures in multi-variate analytical models. This may imply the need for a holistic policy approach that includes both national and state actions. While data document that most drug laws are enforced and cases will be tried at the state level (Ostrom and Kauder, 1999), national policy can set a baseline for and provide a framework within which states can work. The baseline nature of Federal policy may also be crucial for the effectiveness of state policy. State key informants interviewed as a part of an on-going qualitative study addressing state methamphetamine precursor policy noted that one of the major barriers to effective state policy attempts to control STLs was the wide variance in methamphetamine precursor policies (VanderWaal et al., 2007). Specifically, if neighboring states had minimal controls on the purchase of products containing methamphetamine precursor chemicals, it was very easy to purchase needed supplies in those neighboring states for STL activity in the state with existing policy. The interviewed key informants clearly recognized the need for some type of national baseline policy to increase the effectiveness of state policy efforts (VanderWaal et al., unpublished)

The data presented also suggested that a comprehensive policy approach is important. Focusing primarily on penalties within a deterrence framework may not be sufficient in regards to STL reduction efforts. Penalties are not self-enforcing; they require a systematic approach that not only identifies specific enforcement authorities at the state/local levels but also provide the necessary resources to enable such enforcement. In addition, the data clearly suggest that quantity controls combined with clerk intervention at the point-of-purchase consistently related to significant reduction in STL seizures more so than treating violations of precursor laws as a crime. Overall, the data suggest that a comprehensive Federal and state approach that includes designated regulatory agencies that can enforce precursor laws focusing on quantity controls and clerk intervention are crucial policy elements in efforts to reduce the harms associated with STL manufacturing of methamphetamine.

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Table 1. Descriptives (N=2,010)

	% or Mean	Range
Methamphetamine-related lab seizures ^a	19.86	1 - 213
State ephedrine policies		
1. Clerk intervention and quantity/packaging restrictions ^b		
Neither clerk intervention nor quantity/packaging restrictions	64.1	
No clerk intervention, but do have quantity/packaging restrictions	12.3	
Have clerk intervention, but no quantity/packaging restrictions	4.7	
Have both clerk intervention and quantity/packaging restrictions	18.9	
2. Purchase severity		
Non-crime	76.9	
Crime (misdemeanor or felony)	23.1	
State pseudoephedrine policies		
1. Clerk intervention and quantity/packaging restrictions		
Neither clerk intervention nor quantity/packaging restrictions	56.1	
No clerk intervention, but do have quantity/packaging restrictions	12.6	
Have clerk intervention, but no quantity/packaging restrictions	4.0	
Have both clerk intervention and quantity/packaging restrictions	27.3	
2. Purchase severity		
Non-crime	77.4	
Crime (misdemeanor or felony)	22.6	
State policy specification of regulatory/enforcement agency		
No	69.0	
Yes	31.0	
Federal policies		
1. Purchase quantity limits ^c		
Prior to policy	78.9	
After policy	21.1	
2. Clerk intervention ^d		
Prior to policy	92.9	
After policy	7.1	
Year		
2004	35.8	
2005	33.6	
2006	30.7	

Notes: Each case in the data represents one bi-monthly count of seizures per state. Percentages of cases for state policies in each policy category include both those which did not change status during 2004-2006, or which were either pre- or post-policy change.

^a Bi-monthly counts per state.

^b Clerk intervention defined as at least one of the following: behind counter, signature required, ID required, sales to minors prohibited. Quantity/packaging restrictions defined as any restrictions.

^c Federal policy of purchase quantity limits defined as restrictions for non-liquid pseudoephedrine sold to individuals.

^d Federal clerk intervention policy defined as requirements to place methamphetamine precursor products behind counter or in locked cabinet at point of sale, picture ID required, and retailer logbook of sales and staff training.

Table 2. Changes in Methamphetamine-related Lab Seizures Pre- and Post-Federal Precursor Policy, 2004-2006

	States with No Precursor Policies ^a			States with No Precursor Policy Changes, 2004-2006 ^b		
	Mean Seizures	Estimate	p	Mean Seizures	Estimate	P
Federal policies						
1. Purchase quantity limits ^c						
Prior to policy	9.0	(ref)		30.4	(ref)	
After policy	5.6	-0.5522	***	15.0	-0.2905	***
2. Clerk intervention ^d						
Prior to policy	8.5	(ref)		28.4	(ref)	
After policy	5.1	-0.1971		8.8	-0.8727	*
Year						
2004	8.2	(ref)		39.7	(ref)	
2005	9.4	-0.1294		23.0	-0.5915	***
2006	7.1	-0.0098		17.5	-0.5117	***
Model Ns						
N of States	(7)			(2)		
N of cases (bi-monthly count periods)	(411)			(144)		

Notes: All models dealing with seizures occurring at any point following policy effective dates, clustered by state, and including state dummies (results not shown). Mean seizures presented using non-transformed number of seizures. Estimates obtained from models using the natural log of seizures.

^a Includes ID, MI, NV, NY, OH, PA, VA.

^b Includes AR, CA; these states did have precursor policies, but the policies did not change during the study time period.

^c Federal policy of purchase quantity limits defined as restrictions for non-liquid pseudoephedrine sold to individuals.

^d Federal clerk intervention policy defined as requirements to place methamphetamine precursor products behind counter or in locked cabinet at point of sale, picture ID required, and retailer logbook of sales and staff training.

*p<.05; **p<.01; ***p<.001

Table 3A. Changes in Methamphetamine-related Lab Seizures Pre- and Post-State Ephedrine Policy Changes in Clerk Intervention and Quantity/Packaging Restrictions, 2004-2006: States with Changes in Specified State Policies

	<u>Model 1</u>			<u>Model 2</u>			<u>Model 3</u>			<u>Model 4</u>			<u>Model 5</u>	
	Mean	Est.	p	Mean	Est.	p	Mean	Est.	p	Mean	Est.	p	Mean	Est.
<u>State Ephedrine Policy</u>														
Clerk intervention and quantity/packaging restrictions ^a														
Level 1	16.6	(ref)		33.0	(ref)		39.8	(ref)		35.8	(ref)		6.9	(ref)
Level 2	7.7	-0.8537	**	--			--			--			3.3	-0.0000
Level 3	--			9.6	-0.8551	***	--			25.2	-0.4037		--	-0.0000
Level 4	--			--			28.3	-0.6889	***	11.3	-1.6905	*** ^d	2.9	-0.0000
Federal policies														
1. After purchase quantity limit policy ^b		-0.3727			-0.7093	***		-0.4394	**		-0.5172			0.0000
2. After clerk intervention policy ^c		-0.3984	***		-0.5431	*		-0.1434	**		0.0045			-0.0000
Year														
2004		(ref)			(ref)			(ref)			(ref)			(ref)
2005		-0.0049			-0.2544			0.0428			0.0740			-0.0000
2006		0.2799			-0.0559			0.3184	*		0.7569	*		-0.0000
Model Ns														
N of States		(3)			(2)			(9)			(1)			(1)
N of cases (bi-monthly count periods)		(213)			(143)			(529)			(72)			(67)

Notes: All models dealing with seizures occurring at any point following policy effective dates, clustered by state, and including state dummies (results not shown). For models including only one state, no state clustering utilized. Mean seizures presented using non-transformed number of seizures. Estimates obtained from models using the natural log of seizures. States included: AL, AZ, CO, FL, IL, IN, KS, KY, MS, MO, MT, NC, ND, SD, WA, WY.

^a State policy of clerk intervention defined as at least one of the following: behind counter, signature required, ID required, sales to minors prohibited. State policy of quantity/packaging restrictions defined as any quantity or any packaging restrictions:

- Level 1: Prior to either clerk intervention or quantity/packaging restrictions;
- Level 2: Moving to no clerk intervention, but do have quantity/packaging restrictions;
- Level 3: Moving to have clerk intervention, but no quantity/packaging restrictions;
- Level 4: Moving to have both clerk intervention and quantity/packaging restrictions.

^b Federal policy of purchase quantity limits defined as restrictions for non-liquid pseudoephedrine sold to individuals.

^c Federal clerk intervention policy defined as requirements to place methamphetamine precursor products behind counter or in locked cabinet at point of sale, picture ID required, and retailer logbook of sales and staff training.

^d Comparison of state policy levels "c" and "d" significant at p<.001.

*p<.05; **p<.01; ***p<.001

Table 3B. Changes in Methamphetamine-related Lab Seizures Pre- and Post-State Pseudoephedrine Policy Changes in Clerk Intervention and Quantity/Packaging Restrictions, 2004-2006: States with Changes in Specified State Policies

	<u>Model 1</u>			<u>Model 2</u>			<u>Model 3</u>			<u>Model 4</u>			<u>Model 5</u>	
	Mean	Est.	p	Mean	Est.	p	Mean	Est.	p	Mean	Est.	P	Mean	Est.
<u>State Pseudoephedrine Policy</u>														
Clerk intervention and quantity/packaging restrictions ^a														
Level 1	14.5	(ref)		21.1	(ref)		38.4	(ref)		35.8	(ref)		6.9	(ref)
Level 2	7.4	-0.8287	**	--			--			--			3.3	-0.0000
Level 3	--			6.2	-0.5181	*	--			25.2	-0.4037		--	-0.0000
Level 4	--			--			21.6	-0.7521	***	11.3	-1.6905	*** ^d	2.9	-0.0000
Federal policies														
1. After purchase quantity limit policy ^b		-0.3176			-0.4727	***		-0.4997	***		-0.5172			0.0000
2. After clerk intervention policy ^c		-0.4573	***		-0.7400	***		-0.2513	*		0.0045			-0.0000
Year														
2004		(ref)			(ref)			(ref)			(ref)			(ref)
2005		0.0250			-0.3234	***		-0.0288			0.0740			-0.0000
2006		0.2932			-0.2205	***		0.1316			0.7569	*		-0.0000
Model Ns														
N of States	(4)			(2)			(13)			(1)			(1)	
N of cases (bi-monthly count periods)	(237)			(130)			(812)			(72)			(67)	

Notes: All models dealing with seizures occurring at any point following policy effective dates, clustered by state, and including state dummies (results not shown). For models including only one state, no state clustering utilized. Mean seizures presented using non-transformed number of seizures. Estimates obtained from models using the natural log of seizures. States included: AL, AZ, CO, FL, GA, HI, IL, IN, IA, KY, MS, MO, MT, NE, NC, ND, OK, SD, WA, WI, WY.

^a State policy of clerk intervention defined as at least one of the following-: behind counter, signature required, ID required, sales to minors prohibited. State policy of quantity/packaging restrictions defined as any quantity or any packaging restrictions:

- Level 1: Prior to either clerk intervention or quantity/packaging restrictions;
- Level 2: Moving to no clerk intervention, but do have quantity/packaging restrictions;
- Level 3: Moving to have clerk intervention, but no quantity/packaging restrictions;
- Level 4: Moving to have both clerk intervention and quantity/packaging restrictions.

^b Federal policy of purchase quantity limits defined as restrictions for non-liquid pseudoephedrine sold to individuals.

^c Federal clerk intervention policy defined as requirements to place methamphetamine precursor products behind counter or in locked cabinet at point of sale, picture ID required, and retailer logbook of sales and staff training.

^d Comparison of state policy levels "c" and "d" significant at p<.001.

*p<.05; **p<.01; ***p<.001

Table 4. Changes in Methamphetamine-related Lab Seizures Pre- and Post-State Policy Changes in State Policy on Buyer Penalty Severity, 2004-2006: States with Changes in Specified Policy

	State Ephedrine Policy			State Pseudoephedrine Policy		
	Mean Seizures	Est.	p	Mean Seizures	Est.	p
State purchase severity policy						
Initial non-crime severity	30.2	(ref)		29.1	(ref)	
Moving to crime (misdemeanor or felony)	6.5	-0.5969	***	17.5	-0.5435	**
Federal policies						
1. After purchase quantity limit policy ^a		-0.2864	*		-0.3253	*
2. After clerk intervention policy ^b		-0.2852	***		-0.2842	**
Year						
2004		(ref)			(ref)	
2005		-0.2348	*		-0.2462	**
2006		-0.0825			-0.0643	
Model Ns						
N of States	(8)			(8)		
N of cases (bi-monthly count periods)	(508)			(497)		

Notes: All models dealing with seizures occurring at any point following policy effective dates, clustered by state, and including state dummies (results not shown). Mean seizures presented using non-transformed number of seizures. Estimates obtained from models using the natural log of seizures. States included: AL, AZ, CO, MO, MS, MT, NC, SD, WI.

^a Federal policy of purchase quantity limits defined as restrictions for non-liquid pseudoephedrine sold to individuals.

^b Federal clerk intervention policy defined as requirements to place methamphetamine precursor products behind counter or in locked cabinet at point of sale, picture ID required, and retailer logbook of sales and staff training.

*p<.05; **p<.01; ***p<.001

Table 5. Changes in Methamphetamine-related Lab Seizures Pre- and Post State Policy Changes in Specification of Regulatory/Enforcement Agency, 2004-2006: States with Changes in Specified Policy

	Mean Seizures	Est.	p
State policy specification of regulatory/enforcement agency			
Initially no specification	25.7	(ref)	
After specification	12.5	-0.8066	***
Federal policies			
1. After purchase quantity limit policy ^a		-0.4793	**
2. After clerk intervention policy ^b		-0.1490	
Year			
2004		(ref)	
2005		-0.1138	
2006		0.0424	
Model Ns			
N of States	(11)		
N of cases (bi-monthly count periods)	(664)		

Notes: All models dealing with seizures occurring at any point following policy effective dates, clustered by state, and including state dummies (results not shown). Mean seizures presented using non-transformed number of seizures. Estimates obtained from models using the natural log of seizures. States included: AL, GA, HI, IN, IA, KS, MS, ND, OR, WI, WY.

^a Federal policy of purchase quantity limits defined as restrictions for non-liquid pseudoephedrine sold to individuals.

^b Federal clerk intervention policy defined as requirements to place methamphetamine precursor products behind counter or in locked cabinet at point of sale, picture ID required, and retailer logbook of sales and staff training.

*p<.05; **p<.01; ***p<.001

Table 6A. Between-State Differences in Methamphetamine-related Lab Seizure Rates by Ephedrine Precursor Policies, 2004-2006: All Retained States

	Model 1		Model 2		Model 3		Model 4	
	Est.	p	Est	p	Est	p	Est	p
State ephedrine policy models								
1. Clerk intervention and quantity/packaging restrictions ^a								
Level 1	(ref)						(ref)	
Level 2	-0.4199	***					-0.3112	*
Level 3	-0.4982						-0.3211	
Level 4	-0.3144	*					-0.2266	
2. Purchase severity								
Non-crime			(ref)				(ref)	
Crime (misdemeanor or felony)			-0.2586	*			-0.0352	
State policy specification of regulatory/enforcement agency								
No					(ref)		(ref)	
Yes					-0.5269	***	-0.4461	*
Federal policies								
1. After purchase quantity limit policy ^b								
	-0.4771	***	-0.4762	***	-0.4808	***	-0.4818	***
2. After clerk intervention policy ^c								
	-0.3285	***	-0.3295	***	-0.3316	***	-0.3306	***
Year								
2004	(ref)		(ref)		(ref)		(ref)	
2005	-0.3141	***	-0.3735	***	-0.3149	***	-0.2624	***
2006	-0.3394	**	-0.4530	***	-0.3522	***	-0.2442	*

Notes: All models dealing with seizures occurring at any point following policy effective dates, clustered by state, and including state dummies (results not shown). N of states=32; N of cases (bi-monthly count periods)=2,010.

^a State policy of clerk intervention defined as at least one of the following: behind counter, signature required, ID required, sales to minors prohibited. State policy of quantity/packaging restrictions defined as any quantity or any packaging restrictions:

- Level 1: Prior to either clerk intervention or quantity/packaging restrictions;
- Level 2: Moving to no clerk intervention, but do have quantity/packaging restrictions;
- Level 3: Moving to have clerk intervention, but no quantity/packaging restrictions;
- Level 4: Moving to have both clerk intervention and quantity/packaging restrictions.

^b Federal policy of purchase quantity limits defined as restrictions for non-liquid pseudoephedrine sold to individuals.

^c Federal clerk intervention policy defined as requirements to place methamphetamine precursor products behind counter or in locked cabinet at point of sale, picture ID required, and retailer logbook of sales and staff training.

*p<.05; **p<.01; ***p<.001

Table 6B. Between-State Differences in Methamphetamine-related Lab Seizure Rates by Pseudoephedrine Precursor Policies, 2004-2006: All Retained States

	Model 1		Model 2		Model 3		Model 4	
	Est.	p	Est	p	Est	p	Est	p
State pseudoephedrine policies								
1. Clerk intervention and quantity/packaging restrictions ^a								
Level 1	(ref)						(ref)	
Level 2	-0.4728	***					-0.4493	**
Level 3	-0.3971						-0.3564	
Level 4	-0.5721	***					-0.5410	**
2. Purchase severity								
Non-crime			(ref)				(ref)	
Crime (misdemeanor or felony)			-0.2101				0.1947	
State policy specification of regulatory/enforcement agency								
No					(ref)		(ref)	
Yes					-0.5269	***	-0.3250	
Federal policies								
1. After purchase quantity limit policy ^b								
	-0.4832	***	-0.4777	***	-0.4808	***	-0.4836	***
2. After clerk intervention policy ^c								
	-0.3185	***	-0.3272	***	-0.3316	***	-0.3227	***
Year								
2004	(ref)		(ref)		(ref)		(ref)	
2005	-0.2385	**	-0.3784	***	-0.3149	***	-0.2158	**
2006	-0.1875		-0.4657	***	-0.3522	***	-0.1517	

Notes: All models dealing with seizures occurring at any point following policy effective dates, clustered by state, and including state dummies (results not shown). N of states=32; N of cases (bi-monthly count periods)=2,010.

^a State policy of clerk intervention defined as at least one of the following: behind counter, signature required, ID required, sales to minors prohibited. State policy of quantity/packaging restrictions defined as any quantity or any packaging restrictions:

- Level 1: Prior to either clerk intervention or quantity/packaging restrictions;
- Level 2: Moving to no clerk intervention, but do have quantity/packaging restrictions;
- Level 3: Moving to have clerk intervention, but no quantity/packaging restrictions;
- Level 4: Moving to have both clerk intervention and quantity/packaging restrictions.

^b Federal policy of purchase quantity limits defined as restrictions for non-liquid pseudoephedrine sold to individuals.

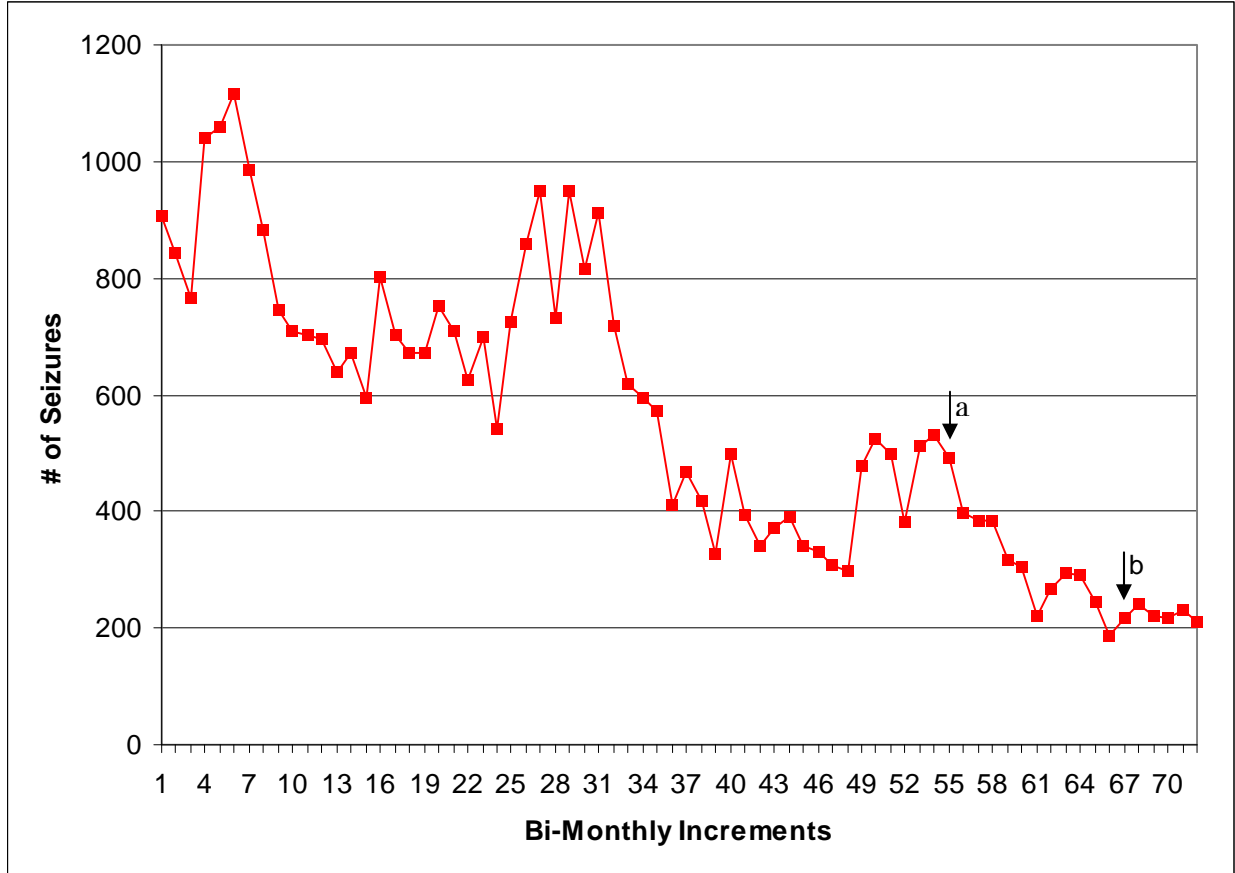
^c Federal clerk intervention policy defined as requirements to place methamphetamine precursor products behind counter or in locked cabinet at point of sale, picture ID required, and retailer logbook of sales and staff training. *p<.05; **p<.01; ***p<.001

Appendix. Federal and Retained State Precursor Policy Enactment and Effective Dates

	<u>Date Enacted</u>	<u>Date Effective</u>	<u>Legal Citation</u>
<u>Federal</u>	03/09/2006	04/08/2006	21 U.S.C. § 802(42)(A) (2006)
	03/09/2006	09/30/2006	21 U.S.C. § 830(e)(1)(A)(ii) (2006)
<u>State</u>			
Alabama	05/20/2004; 05/24/2005	05/20/2004; 07/01/2005	ALA. CODE § 20-2-190
	05/20/2004	05/20/2004	ALA. CODE § 20-2-190 (e)
Arizona	05/20/2005	08/12/2005; 10/31/2005	ARIZ. REV. STAT. ANN. § 13-3404.01
Arkansas	03/30/2001	03/30/2001	ARK. CODE ANN. § 5-64-1103 ARK. CODE ANN. § 5-64-1103 (b)
California	10/10/1999	01/01/2000	CAL. HLTH. & S. CODE § 11100
Colorado	06/07/2002	10/01/2002	COLO. REV. STAT. ANN § 18-18-402
	05/27/2005	07/01/2005	COLO. REV. STAT. ANN § 18-18-412.8
Florida	06/01/2005	07/01/2005	FLA. STAT. ANN. § 893.1495
Georgia	04/19/2005	07/01/2005	GA. CODE ANN. § 16039-30.4 GA. CODE ANN. § 16-13-30.3(b.1)(2) GA. CODE ANN. § 16-13-30.3(b.1)(4) GA. CODE ANN. § 16-13-30.3(b.1)(6)(B)
Hawaii	07/05/2005	07/01/2005	HAW. REV. STAT. § 329-71 2005 Hawaii Laws Act 193
Idaho	- none -		
Illinois	08/24/2004	01/01/2005	720 ILL. COMP. STAT. ANN. 647/10 720 ILL. COMP. STAT. ANN. 647/15 720 ILL. COMP. STAT. ANN. 647/35
Indiana	05/10/2005	07/01/2005	IND. CODE ANN. § 35-48-4-14.7
Iowa	03/22/2005	05/21/2005	IOWA CODE § 124.212 IOWA CODE § 124.401 IOWA CODE § 126.23A IOWA CODE § 126.23B IOWA CODE § 126.23B(1)
Kansas	04/15/2005	06/01/2005	KAN. STAT. ANN. § 65-1643
	05/13/1999	05/13/1999	KAN. STAT. ANN. § 65-7006
Kentucky	04/02/2002	07/15/2002	KY. STAT. ANN. § 218A.1438
	03/18/2005	06/20/2005	KY. STAT. ANN. § 218A.1446
Michigan	- none -		
Mississippi	07/01/2005	07/01/2005	MISS. CODE ANN. § 41-29-139 MISS. CODE ANN. § 41-29-315
Missouri	06/15/2005	06/15/2005	MO. REV. STAT. § 195.017 MO. REV. STAT. § 195.417
Montana	05/02/2005	07/01/2005	MONT. CODE ANN. § 50-32-502
Nebraska	05/31/2005	09/04/2005	NEB. REV. STAT. § 28-456 NEB. REV. STAT. § 28-456(1)(e)
Nevada	- none -		
New York	- none -		

North Carolina	09/27/2005	09/27/2005	N.C. GEN. STAT. § 90-113-52 N.C. GEN. STAT. § 90-113-53 N.C. GEN. STAT. § 90-113-56
North Dakota	04/22/2005	06/01/2005	N.D. CENT. CODE § 19-03.4-08 N.D. CENT. CODE § 19-03.4-08(3)(b)
Ohio	- none -		
Oklahoma	06/10/1996 05/22/2002 04/06/2004	06/10/1996 07/01/2002 04/06/2004	OKLA. STAT. ANN. tit.63, § 2-101, 201 OKLA. STAT. ANN. tit.63, § 2-333 OKLA. STAT. ANN. tit.63, § 2-212(b)
Oregon	06/26/2001; 08/16/2005	01/01/2002; 08/16/2005	OR. REV. STAT. § 475.973
Pennsylvania	- none -		
South Dakota	02/25/2005	07/01/2005	S.D. CODIFIED LAWS ANN. § 34-20D-1 S.D. CODIFIED LAWS ANN. § 34-20D-3
Virginia	- none -		
Washington	05/11/2005	10/01/2005	WASH. REV. CODE ANN. § 69.43.105
Wisconsin	05/06/2005 06/07/2005	05/07/2005 06/21/2005	WIS. STAT. ANN. § 961.11 WIS. STAT. ANN. § 961.23 WIS. STAT. ANN. § 961.41
Wyoming	03/15/2005	07/01/2005	WYO. STAT. ANN. § 35-7-1059(g) WYO. STAT. ANN. § 35-7-1059(j) WYO. STAT. ANN. § 35-7-1059(k) WYO. STAT. ANN. § 35-7-1059(m)

Figure 1
Total Methamphetamine-Related Seizures in 32 Retained States, 2004-2006



Notes: (a) Effective date of Federal quantity restrictions for non-liquid pseudoephedrine sold to individuals.

(b) Effective date of Federal restrictions requiring methamphetamine precursor products to be placed behind the counter or in a locked cabinet prior to sale. Further, buyers must present picture identification at time of purchase, and retailers must maintain logbook of sales and provide training to staff.

Figure 2
Methamphetamine-related Seizures by Seizure Type in 32 Retained States, 2004-2006

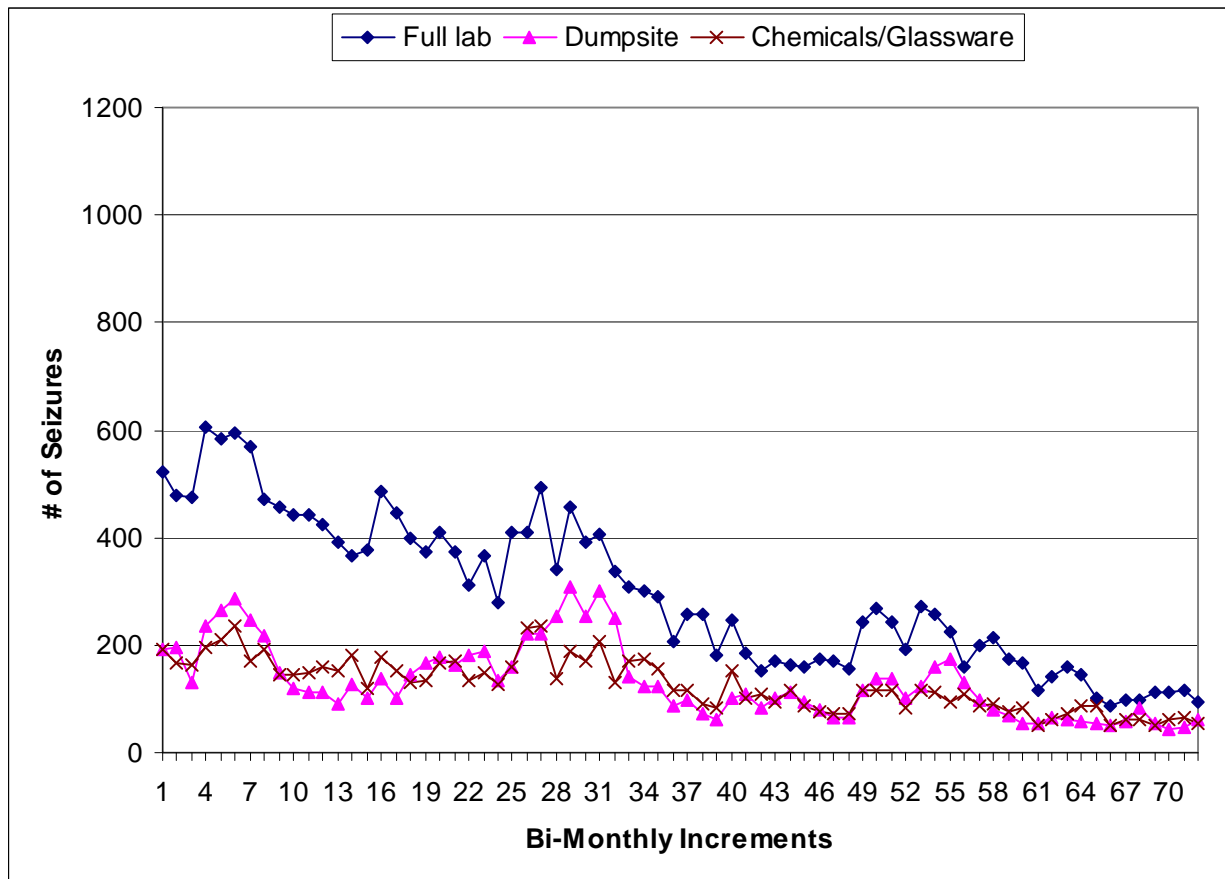
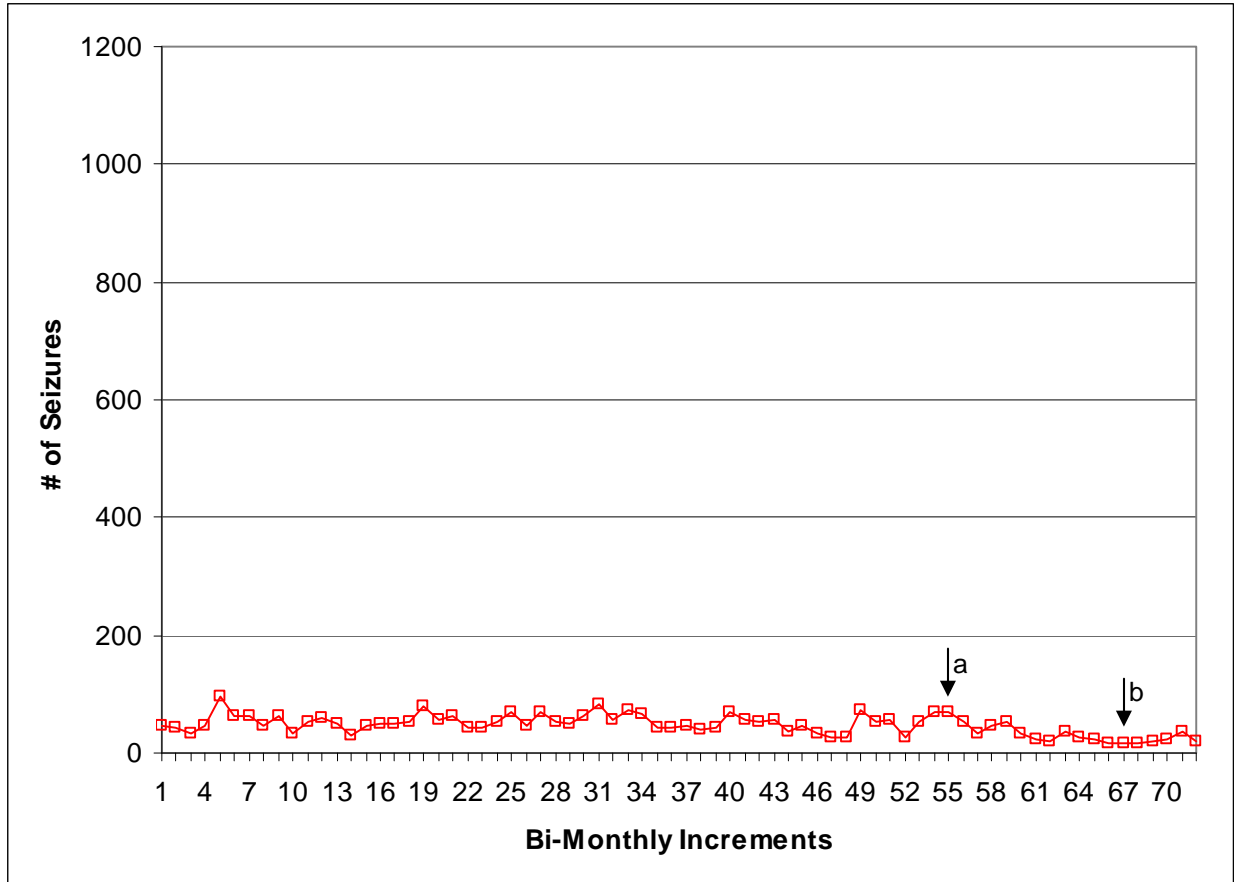


Figure 3
Total Methamphetamine-Related Seizures in Retained States with
No State Precursor Laws, 2004-2006

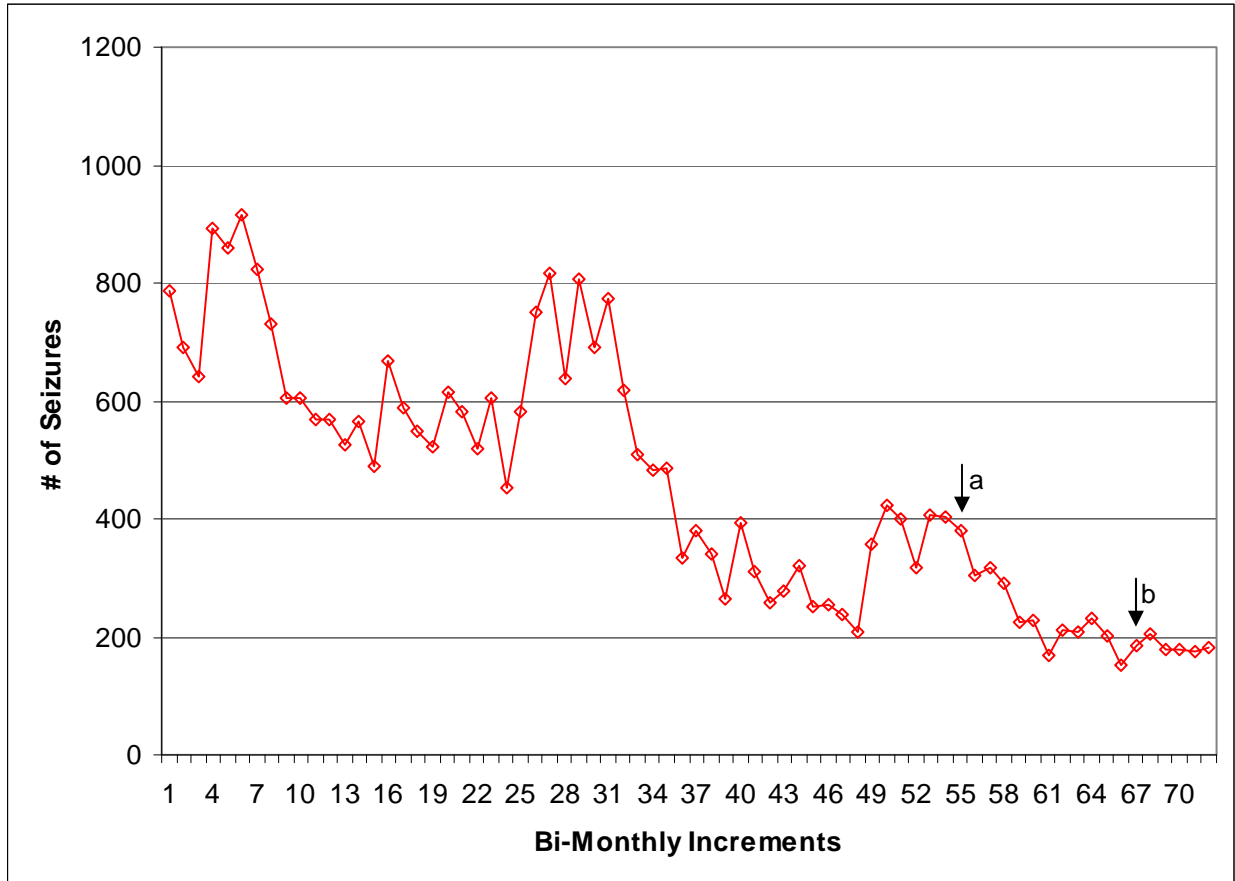


Notes: N=411. Includes ID, MI, NV, NY, OH, PA, VA.

(a) Effective date of Federal quantity restrictions for non-liquid pseudoephedrine sold to individuals.

(b) Effective date of Federal restrictions requiring methamphetamine precursor products to be placed behind the counter or in a locked cabinet prior to sale. Further, buyers must present picture identification at time of purchase, and retailers must maintain logbook of sales and provide training to staff.

Figure 4
Total Methamphetamine-Related Seizures in Retained States with State Precursor Laws becoming Effective during 2004-2006



Notes: N=1,455. Excludes ID, MI, NV, NY, OH, PA, VA (no laws); AR, CA (had some/all of the investigated laws, but did not change during study period).
(a) Effective date of Federal quantity restrictions for non-liquid pseudoephedrine sold to individuals.
(b) Effective date of Federal restrictions requiring methamphetamine precursor products to be placed behind the counter or in a locked cabinet prior to sale. Further, buyers must present picture identification at time of purchase, and retailers must maintain logbook of sales and provide training to staff.