NEED FOR SUBSTANCE ABUSE TREATMENT IN MARYLAND
FINAL REPORT

Revised, December 15, 2008

William E. McAuliffe, PhD
Department of Psychiatry
Harvard Medical School
Cambridge Health Alliance
Cambridge, MA

Margaret Hsu, MHS
Erin Artigiani, MA
Eric D. Wish, PhD
Center for Substance Abuse Research (CESAR)
University of Maryland, College Park
4321 Hartwick Rd., Ste 501
College Park, MD 20740
cesar@cesar.umd.edu

This project was supported by a grant from the Maryland Department of Health and Mental Hygiene, Alcohol and Drug Abuse Administration to the Center for Substance Abuse Research at the University of Maryland, College Park, under DHMH agreement number DHMH-OCPMP 08-9720G.

PREFACE

During the 2007 legislative session, Delegate Peter A. Hammen, Chair of the Health and Government Operations Committee, and 22 of his colleagues sponsored HB 850. This bill required the Alcohol and Drug Abuse Administration (ADAA) to conduct a needs assessment "for prevention, diagnosis, and treatment of drug misuse and alcohol misuse in the State." This assessment is expected to "identify the financial and treatment needs of each jurisdiction and of each drug treatment program operated by the State."

The ADAA subsequently contracted with the Center for Substance Abuse Research (CESAR) at the University of Maryland, College Park, to conduct the treatment needs assessment. CESAR staff previously conducted needs assessments for the State in 1998 and 2002 as part of the Substance Abuse and Mental Health Services Administration's (SAMHSA) national program for assessing state treatment needs.

Dr. William McAuliffe of the Department of Psychiatry at Harvard Medical School was funded by SAMHSA to direct the National Technical Center in order to advise all of the states as they conducted their needs assessments. In addition to being a nationally recognized expert in the field of treatment needs assessment, Dr. McAuliffe has an intimate knowledge of Maryland. He was born in East Baltimore, educated in Baltimore's schools, received his bachelor's and doctorate degrees from Johns Hopkins University, and conducted award-winning drug research on Baltimore's street corners. For all of these reasons, CESAR engaged him to collaborate with its staff and to direct Maryland's treatment needs assessment. This report provides results from the study.

ACKNOWLEDGEMENTS

We would like to thank the staff of the Alcohol and Drug Abuse Administration (ADAA) and members of the Maryland Drug and Alcohol Abuse Council for their efforts over the past year. Their dedication to understanding and addressing drug use and the need for treatment and prevention programs in Maryland makes this report possible. Their willingness to assist in this project and plan for the future is commendable.

In addition, we would like to thank William Rusinko for his invaluable guidance in the use and interpretation of ADAA treatment data. Special thanks are also offered to the staff at the following agencies for providing the research team with data and assistance which made this report possible:

- The Maryland Alcohol and Drug Abuse Administration
- The Maryland Department of State Police
- The Maryland Vital Statistics Administration
- Center for Surveillance and Epidemiology, Maryland AIDS Administration
- Maryland Health Services Cost Review Commission
- The Maryland State Highway Administration
- Comptroller of Maryland
- The Substance Abuse and Mental Health Services Administration, Office of Applied Studies

JoAnn Scherer-Gonzales and Kaitlyn McAuliffe edited the report.

EXECUTIVE SUMMARY

Introduction

This report describes the development of a measure of substance abuse treatment service needs among Maryland's counties and Baltimore City. The Alcohol and Drug Abuse Administration (ADAA) of the Maryland Department of Health and Mental Hygiene commissioned this study of treatment needs from the Center for Substance Abuse Research (CESAR) at the University of Maryland. After creating a composite of validated substance abuse indicators, the study used the resulting Substance Need Index (SNI) as the independent variable in a statistical equation to estimate relative gaps in treatment services among the state's counties.

Methods

The study used a methodology developed by Harvard University researchers over the past two decades to assess the relative need for substance abuse treatment in states and substate areas. Rather than indicators of casual use of alcohol or controlled drugs, the SNI and counterpart Drug Need Index (DNI) and Alcohol Need Index (ANI) used indicators of serious substance-use disorders. The components of the need indexes were mean rates of drug and alcohol mortality, hospital discharges, and arrests. The study used five years of data from 2001 to 2005 and cleaned them carefully in an effort to attain the highest achievable level of reliability. Classical psychometric methods assessed the reliability and validity of the three need indicators. The composite need indexes were unweighted sums of standardized versions of the three validated indicators. The study team assessed the reliability and construct validity of the indexes, and scaled the indexes to range from 0 to 100. For example, a DNI of 0 described a county that had no drug deaths, arrests, or hospital discharges, while the value of 100 described a county with the highest observed five-year rates for all three drug indicators. The study used a linear regression of the SNI on five-year mean substance abuse treatment admission rates to estimate relative treatment gaps and the number of new admissions required to close the gaps. The analysis assumed that the proportion of admissions to publicly-funded programs in each county during the study period would apply to the funding mix in the near future.

Results

The need indicators had substantial reliability and validity. The initial cleaning of the data sets revealed little missing data and few apparent data errors in the indicators. A constant error in Howard County's admission statistics compiled by the state eventually came to light and led to a revision of the study's results and to this revised final report. Reliability estimates, as measured by Cronbach's alpha, were .99 for the substance arrest, hospital discharge, and treatment admission rates. The alpha estimate for substance mortality rates was .94. The drug need indicators showed evidence of convergent validity. There was also evidence of convergent validity for the alcohol mortality and hospital discharge rates, but such evidence was limited for the alcohol arrest rates. The alcohol arrest rates appeared to reflect alcohol problems that were most prevalent in rural and vacation areas, whereas alcohol mortality and hospital discharge rates reflected alcohol problems most prevalent among urban dwellers. In particular, Baltimore City's very high rates of alcohol mortality and hospital discharges but very low rate of alcohol arrests for drunk driving affected the validity analysis. Despite the relatively low correlations between the alcohol arrest rates and the other two alcohol indicators, the Alcohol Need Index performed better with the alcohol arrest variable included. Inclusion of the alcohol arrest indicator was also dictated by theoretical and methodological considerations. The three substance abuse indicators explained nearly equal amounts of the SNI's variations. The pattern of correlations with other drug and alcohol indicators with the DNI and ANI provided evidence of the construct validity of the two need indexes.

All of the indicators examined showed that the extent of drug and alcohol problems varied greatly among counties. The number of alcohol-related deaths, arrests, and hospital discharges exceed the counterpart number of drug deaths, arrests, and hospital discharges, and yet there were more primary drug treatment admissions than primary alcohol treatment admissions.

The need index scores were consistent with most expectations regarding the distribution of substance abuse problems in Maryland. Baltimore City's SNI score (91) was the highest by far, while the two next highest SNI scores were on the Eastern Shore: Worcester County's (55) and Dorchester County's (42). No other county had an SNI score above 40. Substance abuse treatment needs were lowest in suburban areas surrounding the District of Columbia (e.g., the SNI in Montgomery County was 11), in counties west of Baltimore County (Howard 14, Carroll 18, and Fredrick 18), and in Western Maryland (Garrett County 20). Prince George's County's SNI of 15 was lower than some observers expected, but its low score mainly reflected low alcohol indicators. Perhaps the most surprising results were the relatively high rates of treatment needs on the Eastern Shore, including Worcester, Dorchester, Talbot (34), Cecil (33), Kent (28), Wicomico (26), and Caroline County (24).

There was a good match between county treatment need and admission rates. The SNI explained 72% of the variance in the total substance abuse treatment admission rates. Inclusion of a measure of poverty failed to add significantly to the indicator model's explanatory power. The areas of greatest unmet need were the suburban counties outside of the District of Columbia, Baltimore County and its surrounding counties (Anne Arundel, Harford, and Carroll), Baltimore City, the western counties, and Cecil County. Because Baltimore City was an extreme outlier, our sensitivity analysis suggested that Baltimore City's treatment gap may be larger than our initial statistical analysis indicated.

Conclusions

Methods originally developed in other states to assess treatment needs were effective in Maryland. The Maryland indicator data were high in quality, and the study's indexes had substantial evidence of reliability and validity. The large inter-county variations in need and treatment indicators did not support the assumption that a constant percentage of every county's population had drug or alcohol problems. The need and treatment indicators suggested that there was a statewide shortage of alcohol admissions compared to drug admissions. Treatment needs in Maryland were highest in Baltimore City by a wide margin. Our study of indicators in counties nationwide found that Baltimore City's drug and alcohol problems were among the most severe in the country, especially its drug problems. Although current treatment allocations fit the variations in need reasonably well statewide, the admission rates in some counties were lower than their substance abuse treatment need scores predicted. Baltimore City had the highest rate of treatment admissions, but it nevertheless did not meet the level of admissions to be expected based on its SNI score. Among the seven counties with the largest treatment gaps were four (Prince George's, Montgomery, Howard, and Harford) with SNI scores below the median, but they also had especially low levels of treatment admissions.The study's methodology allows planners and policy makers to identify when relatively high admission rates are still not high enough to satisfy its residents' treatment needs, and when relatively low admission rates are too low to meet the county population's needs.

The relative treatment gaps could be eliminated by a moderate, potentially achievable increase in statewide treatment admissions and targeting of the new admissions to counties with the greatest amount of unmet need. The largest relative treatment admissions gaps per 100,000 were in Allegany County (550), Prince George's County (493), Baltimore County (434), Howard County (397), Cecil County (259), Montgomery County (254), Harford County (249), Worcester County (160), Fredrick County (120), Baltimore City (116), Anne Arundel County (101), Carroll County (76), Garrett County (43), St. Mary's County (24) and Washington County (18). If all of the gaps were completely eliminated so that these counties had treatment admissions rates consistent with estimated need, an additional 13,807 admissions per annum would be required. If the proportion of public and private funding in each county remained unchanged, an additional 7,287 admissions in state-funded facilities would be needed. If the sensitivity analysis estimates for Baltimore City and Worcester County were used, the number would increase by 1,446 admissions per annum to 8,733. This amount would represent a 18.5% increase in the 47,122 admissions to publicly-funded facilities reported in Fiscal Year 2007 (Maryland Alcohol and Drug Abuse Administration 2008).

Limitations

The state should exercise appropriate care in applying these techniques that are new to Maryland. We have devoted two decades of research to divising, testing, and refining this methodology at the interstate, regional, county, and town levels. No competitive approach has been studied as thoroughly. We have adapted the methodology to Maryland with great care. The state should nevertheless conduct research to monitor the results of its application in Maryland and be alert for additional refinements of Maryland's substance abuse need index. Like any research technique, there is always room for improvement.

The study thoroughly evaluated the Maryland indicator data's reliability and validity, but data quality should be re-evaluated on an on-going basis. This study has found that the need indexes have substantial levels of reliability and validity. Nevertheless, data quality can change, and the relationship between need and supply of services can change somewhat over a period of years. We recommend a program of continuing research to assess and refine the measurement and regression modeling components of the index methodology. As additional years of data are added to the index, the ongoing evaluation should subject them to the standard techniques that we used in this study. Moreover, even an index with a high level of validity when all counties are considered may include a score for an individual county that raises questions from local officials and providers. In the present study, we have closely examined questions raised concerning the SNI score for Prince George's County and found the result to be sound. In such cases, we recommend employing a series of other indicators (e.g., the validators used in this study) to corroborate the index score in question. We also found that the state treatment admissions statistics for Howard County provided by the state had a systematic error, and its correction modified parameters of the regression model and the treatment gap estimates for several counties.

Over the long run, the best method of insuring an increasingly accurate estimate of need for every county in the future is to increase the number of valid index components. While few indicators meet the methodology's stringent selection criteria, one obvious indicator that might be added is the results of a survey of drug and alcohol use disorders in the general household population. The NSDUH regional interview survey estimates and state school questionnaire survey results were not suitable for this purpose. The state should consider adding a treatment needs module to the Maryland Behavioral Risk Factor Surveillance Survey (BRFSS) which is conducted in a large sample of Maryland households by telephone each year. Researchers should also examine the potential measurement effects of residents traveling across state lines to obtain hospital care of substance abuse complications, die, commit crimes, or obtain treatment. Although our brief investigation found no indications that such cases impacted the current results, more elaborate methods of adjusting for the effects of visitors and temporary workers on need estimates in vacation destinations might be investigated.

Current regression estimates are likely to change as treatment gaps are closed. Using regression and correlational analysis in Maryland, especially with regard to Baltimore City's unmet needs, faced inherent technical challenges because of Baltimore's extremely high levels of need and services relative to the other counties. Our sensitivity analysis of the regression estimates suggested that this effect was relatively minor for all counties except for Baltimore City and Worcester County, but it was enough in those two places to alert officials to the importance of looking closely at other indications of unmet need in Baltimore City and Worcester County. In the meantime, the state may wish to consider giving the people in those two jurisdictions the benefit of the doubt until these technical questions are fully investigated. With little research in the field on the functional relationship between aggregate need and service utilization, the current regression estimates descriptively summarize the existing system of allocation of public and private services and the forces that shaped it. The regression modeling does not embody an ideal relationship between the measure need and treatment services. We recommend on-going research on the regression model to insure that its estimates continue to have validity.

INTRODUCTION

This report describes an assessment of the substance abuse treatment needs of Maryland counties conducted for Maryland’s Alcohol and Drug Abuse Administration (ADAA) by the Center for Substance Abuse Research (CESAR) at the University of Maryland, College Park. The study sought to develop and validate a methodology that could be used in Maryland to assess county treatment needs for the current period and in the future.

Description of Study

Using substance abuse indicator rates from 2001 to 2005, the study developed indexes of the need for substance abuse treatment services in each of the state’s 23 counties and Baltimore City. [1] The study team then analyzed the statistical relationship between the substance abuse need scores and treatment admission rates. We used the results to estimate relative gaps in treatment services. By design, the study’s treatment need indexes included indicators of serious substance-use problems rather than indicators of occasional alcohol use or experimental nonmedical use of controlled and illicit drugs. The indicators used archival information from state agencies on deaths caused by substance use, hospital discharges for patients with diseases caused by alcohol and drug use, and arrests for substance-related crimes. The five years of data analyzed in this study were the most recently available complete set of need indicator and treatment admission statistics when the research began.

In this effort, the CESAR research team used a methodological framework developed during needs assessment research for other states and the country as a whole by Harvard University researchers (McAuliffe 2004, 2005; McAuliffe et al. 1991, 1998, 1999, 2000, 2001a, b, c, d, 2002a, b, 2003; McAuliffe and Dunn 2004; Breer et al. 1996). The framework had two components. The first component included procedures for collecting and processing the indicator data. They consisted of selecting theoretically direct indicators, cleaning the data thoroughly, assessing the reliability and empirical validity of the component indicators, creating parallel drug, alcohol, and substance abuse need indexes, and assessing the reliability and validity of the composite indexes. The second component analyzed a statistical regression analysis of the substance abuse need index scores on substance abuse treatment admission rates, and used the residual differences between the predicted and observed admission rates to measure treatment gaps. Based on the current mix of publicly and privately funded services in each county, the study team estimated how many new state-funded treatment admissions would close the public component of the treatment gaps.

The Study’s Objective

The specific goals of this needs assessment study were to determine whether or not this methodology is applicable in Maryland and to demonstrate the method’s utility by estimating the extent to which counties currently have a lower relative amount of substance abuse treatment than would be expected by an objective estimate of the population’s need for treatment in 2001-2005.

---

[1] Henceforth in this report, references to “counties” will include Baltimore City, even though technically it is not a county.

A variety of factors may cause publicly and privately funded treatment admission rates to fall below the level of need in a county. There may be too few public treatment slots allocated to the county by the state. Existing public treatment resources may not be used efficiently, which may be due to a non-optimal admission process (red tape), having treatment modalities that do not appeal to substance abusers (drug free outpatient counseling versus opioid maintenance), dependence on expensive long-term residential treatment rather than less expensive short-term outpatient treatment, community resistance to locating new facilities where needed most, and poor location of existing facilities relative to substance abusers' homes. Also relevant may be inadequacies in the public transportation systems in suburban or rural counties, as well as an under-developed advertising, public relations, and referral system. The county may fail to spend allocated resources on treatment services, and it may have experienced rapid turnover of personnel at treatment agencies and primary referral agencies (e.g., criminal justice agencies). Similarly, admissions to privately-funded treatment programs may be lower than required to meet population needs due to insufficient numbers of private facilities, inadequate health insurance coverage of populations most at risk (e.g., young adults, lower-middle income families, and minority groups), and insurance benefits that provide limited reimbursement of chronic substance abuse disorders. Other factors may include failure of private treatment agencies to apply for available foundation resources and grants from federal substance abuse programs, community resistance to for-profit substance abuse treatment programs, under-developed employee and student assistance programs in companies and schools, and poor private referral systems.

A clear understanding of these factors in each county is essential for efficiently closing gaps in public and private treatment services. However, investigating those factors is beyond the scope of this work, which focuses on developing a methodology for establishing whether gaps exist and how large they are in particular counties. The study team assumed that others would determine why treatment gaps have occurred and how best to fill them.

Methods of Allocating Treatment Services Traditionally Used by States

In 1995, the staff of the National Technical Center (NTC) for Substance Abuse Needs Assessment (Deykin et al. 1995) conducted interviews with substance abuse agency directors from every state regarding the range of methods that they used to allocate treatment resources to substate areas. The results showed that there was no single objective method that had been universally embraced by states for this purpose.

A. *Historical Precedence*. Most state directors said that they relied heavily on historical precedence as their guide. In a typical example, a program opens up in an area, say, with federal grant funds, and the state does not want to have the patients turned out of treatment when the federal grant ends. So, state funds replace the federal funds thereafter. Or an area might experience a mini-epidemic; or the local newspaper writes a series of articles about the county's alcohol or drug problems. Local programs are oversubscribed, and there are long waiting lists. The county and state officials respond to the resulting public concerns and political pressure by providing funds for additional programming in the county. Once a program is funded, the state maintains funding as long as there is sufficient utilization to suggest that the need continues. The amount of funding from year to year mostly reflects changes in the state's overall treatment budget: if the state's annual budget for substance abuse treatment goes up 2%, most programs or counties are allocated 2% more than their current funding level. The primary concern about this approach is that population changes that affect drug or alcohol problem rates eventually cause treatment gaps over time. Discouraged applicants drop off of waiting lists as they grow in size, and there is no valid measure of the relative size of the gaps in counties with chronic shortages.

B. *Per Capita Allocation, with Overweighting of a High Risk Subpopulation*. Desiring to employ objective criteria to prevent the development of gaps, some states use the federal Block Grant formula or a variation of it to allocate services. The federal formula is essentially a population-based or per capita estimate, except that the percentage of urban youth is double-counted. When applied to substate regions, counties, or towns, this formula implicitly assumes that the rate of substance abuse is the same in every area except for the extent of its urban youth population, and urban youth populations in every area are assumed to need treatment at twice the rate for the rest of the population. Although the original rationale for doubling the youth population reflected the results of substance abuse survey analysis, we know of no recent attempts to use epidemiological data to verify the continuing validity of that assumption.

C. *Social Indicators*. To address the limitations of the assumptions underlying per capita allocation, some states have adjusted per capita allocations according to one or more sociodemographic characteristics believed to correlate with substance abuse, such as the percentage of the population below 200% of the federal poverty level of income or the percentage of female-headed households (Herman-Stahl et al. 2001; Lesage et al. 1996; Aoun 2004). The resulting formula is used to predict relative differences in county substance abuse treatment admissions. These census measures are often called "social indicators," a term not to be confused with the "substance abuse indicators" such as drug mortality rates in this study (see below). The major shortcoming of the social-indicator approach is that it has no established theoretical basis or independent empirical evidence that the indirect indicators measure substance abuse treatment needs rather than some empirically related concept. Besides need, the correlation of demographic variables with treatment admissions could stem from differential community acceptance of treatment facilities, presence of mental health facilities in the area, and high rates of health insurance such as Medicaid. The correlation of social indicators with admissions may therefore primarily reflect factors such as poverty rather than the presence of severe substance abuse problems. We believe that indirect social indicator models are unlikely to achieve the level of validity and acceptance that can be achieved by using direct substance abuse indicator models.

D. *State Household Substance Abuse Needs Assessment Surveys*. Surveys are sometimes used by themselves in needs assessments when states can afford the time and cost of interviewing a large enough household sample. Texas and New York were pioneers in conducting statewide needs assessment surveys (Frank 1985; Frank and Lipton 1984; Spence et al. 1989). Most state household substance abuse surveys have resembled the National Survey of Drug Use and Health (NSDUH), and recently the questionnaires have been administered by computer-assisted telephone interviewing of household residents because it costs less than face-to-face administration (Frank 1985; McAuliffe et al. 1991).

Household substance abuse surveys were greatly enhanced in the 1980s when the federally-funded Epidemiological Catchment Area (ECA) Study developed the Diagnostic Interview Survey (DIS). Using the DIS, non-professional survey interviewers could collect data that would allow analysts to diagnose drug and alcohol abuse and dependence using clinical criteria promulgated by the American Psychiatric Association (1980). The results could be used to estimate substance abuse treatment needs (Regier et al. 1984; Robins et al. 1981; Shapiro et al. 1985). McAuliffe et al. (1991) incorporated the ECA's diagnostic questions for drug use disorders in a telephone drug abuse needs assessment survey of Rhode Island. Using a refined version of the McAuliffe et al. survey methodology, Maryland conducted a treatment needs assessment household survey in the mid-1990s (Petronis and Wish 1996), and a subsequent Maryland needs assessment supplemented the household survey results with diagnostic data from arrestees (Reuter et al. 1998). Unfortunately, these Maryland studies are now ten years old. Mounting another survey of sufficient size would be expensive, and the results would not be available for several years. Moreover, the surveys were designed to measure unmet need at the state level, and there is little research on the reliability or validity of survey estimates for assessing relative treatment need at the county level.

Substance surveys have major limitations when used to obtain treatment estimates for counties instead of entire states. Small county subsamples tend to yield unreliable estimates. As will be shown below, no survey is likely to have nearly as many cases as are counted each year with regard to hospital discharges, drug and alcohol related arrests, or treatment admissions. Epidemiologists are aware that even national estimates of substance use disorder prevalence vary substantially from household survey to survey (Narrow et al. 2002; Gfroerer et al. 1997). In addition, survey estimates of unmet need have typically been unrealistically high, far above existing service rates or levels that the legislature could possibly meet (Regier et al. 2000; Narrow et al. 2002). Experts have long believed that a disproportionate number of "cases" in the diagnostic substance abuse surveys are too mild and transient to need professional treatment (Midanik et al. 2007). The public is generally skeptical about the validity of household surveys of substance abuse. Substance abuse researchers have generally accepted that survey estimates are valid, but that acceptance is not based on empirical findings, for there is little published research on the validity of survey estimates of state, county, town, or regional substance use disorder rates.

E. *Generalizing National Survey Estimates to Counties.* Because even telephone substance abuse surveys are too expensive for states to conduct as often as they desire to estimate treatment need, many states have opted for one of several inexpensive ways of using existing survey estimates. The simplest and least satisfactory is to generalize national survey estimates to all of the state's counties. The state may use the national estimate from the National Comorbidity Study (NCS) or the National Epidemiological Survey on

Alcohol and Related Conditions (NESARC). It may also use the National Survey on Drug Use and Health's estimate of the state's rate of substance use disorders. If that estimate is 8%, the approach assumes that substance abusers in every county equal 8% of the population. This allocation method is statistically equivalent to a per capita allocation, and has the same limitations.

F. *Synthetic Estimation.* The drawbacks of assuming that the national or state substance abuse rate is equally prevalent in every county has led many states to more refined versions of generalizing published survey results to their substate areas. "Synthetic estimation" is a method that applies substance abuse prevalence rates for demographic groups (e.g., age, sex, race, and ethnicity) from national surveys to smaller geographic areas based on their demographic composition estimated in the most recent national census (Rhodes 1993; Wilson and McAuliffe 2000; DATACORP 2004). The method assumes that the substance abuse prevalence rates for each demographic group generalizes to every county, and the overall county estimate will be enhanced by adjusting for county variations in their age, sex, racial, and ethnic compositions (DATACORP 2004).

G. *NSDUH Model Estimates of Substate Regions.* Recently, the National Survey on Drug Use and Health (NSDUH) developed a Bayesian modeling approach to estimating substance use disorder rates in substate regions of either single large counties or clusters of contiguous small counties. The method may be viewed as a sophisticated version of synthetic estimation. The NSDUH's multivariate statistical estimation models use survey data on substance use disorders from Maryland as well as all other states, census demographic data from Maryland's substate areas, and substance abuse indicator data from the areas (e.g., deaths, arrests, and treatment admissions). Even though the NSDUH collects interview data from every state, the statistical modeling of national survey, census, and indicator data are necessary to obtain reliable estimates, even at the state level. Only eight states have a sample large enough to yield reliable state survey estimates of people in need of substance abuse treatment. Most state samples are approximately 1,000 per year, and not every county is sampled. If all Maryland counties were sampled equally, only about 40 cases would be available each year to estimate the county rates of substance use disorders, which are relatively rare phenomena in many counties. To bolster the reliability of the model estimates further, the NSDUH uses survey data from two or three years in the analysis. Despite these many efforts, we found that the NSDUH's Maryland estimates were not reliable from period to period. The Office of Applied Studies has published analyses indicating that the model estimates appear to predict the results of survey interviews in the few large states, but the question of whether the survey estimates themselves are valid has not been addressed.

H. *Substance Abuse Indicators.* Substance abuse indicators are used in this study. They include measures such as alcohol mortality and drug arrests. When interviewed in 1995, some state directors said they did not use substance abuse indicators because of uncertainty about the indicators' validity, no doubt reflecting conclusions from several early articles on the topic (e.g., DeFleur 1975; Furst and Beckman 1981). Numerous more recent studies have examined the validity of substance abuse indicators (e.g., Cleary 1979; Woodward et al. 1984; Beshai 1984; Simeone et al. 1993; Beenstock 1995; Gruenewald and Ponicki 1995; Lesage et al. 1996; Sherman et al. 1996; Mammo and French 1998; Chong 1998; Jonas et al. 1999; Rosenfeld and Decker 1999; Olson 2002; Gregoire 2002; Dickey et al. 2004; Hembree et al. 2005; Hannon and Cuddy 2006). After reviewing this evidence, many states have conducted substance indicator studies of the geographic adequacy of their treatment allocations. Confirming the validity of substance abuse indicators in Maryland was a primary task of this study.

A comprehensive critique of the needs assessment approaches used by Maryland and other states is beyond the scope of this study. Other authors have reviewed needs assessment methods, pointing out their features, strengths, and limitations (Warheit et al. 1977; McBride and McCoy 1985; Richards 1985; Wilson and Hearne 1986; Ingram 1988; Maddock et al. 1988; Center for Substance Abuse Treatment 1992; Simeone et al. 1993; Fiorentine 1994; DeWitt and Rush 1996; Aoun et al. 2004). Little comparative validation research has been conducted among different needs assessment methodologies (Gruenewald and Ponick 1995; Roizen et al. 1999; Aoun et al. 2004).

Our own research convinced us that the best method for estimating unmet treatment needs was to use substance abuse indicators. We used the substance abuse index approach to identify relative treatment gaps among all 50 states and among substate areas of Rhode Island (twice), Alaska, Colorado, Massachusetts, Montana, and North Dakota (McAuliffe et al. 1991, 1998, 2001a, b, c, 2002b, 2005). The substate studies confirmed the reliability and validity of the substance abuse indicators at the town, county, and regional levels of analysis. In the interstate studies, McAuliffe and his colleagues (McAuliffe 2004; McAuliffe and Dunn 2004; McAuliffe et al. 1999, 2000, 2002, 2003) compared the composite need indexes with the model estimates of substance use disorders from the NSDUH. The results of the studies favored the substance abuse indicator approach (McAuliffe and Dunn 2004; McAuliffe 2004). These empirical results, as well as the theoretical and practical considerations discussed above, were the justifications for taking this approach when developing a method of assessing treatment need in Maryland. In this study we examined the validity of using the measurement methods in Maryland. This report recommends ongoing studies to monitor the validity of the need index and confirm the validity of the statistical methodology’s gap estimates.

METHODS

This section of the report explains the procedures that were followed to achieve the study’s objectives.

Reliability and Validity

From beginning to end, the study emphasized reliability and validity in both process and outcome. As noted in the introduction, some state substance abuse agency directors avoided using substance abuse indicator data because of concerns that the indicators may not have sufficient reliability and validity. Counties whose resource allocations may be affected by the study’s results deserve to have confidence in the soundness of the need indexes. Although the studies described above have shown that substance abuse indicator analyses at the state and substate levels of analysis have substantial reliability and validity, the results are not widely known and skepticism about the indicators is still common. Moreover, the body of evidence on validity and reliability is not yet sufficiently large and broad that it would be safe to generalize the results to Maryland without verification. It was therefore essential to design the indicators to achieve reliability and validity at every stage and to verify the results. The approach was to combine high quality components in a properly-designed index to achieve high-quality measurements, and to verify their validity as rigorously as the data allowed.

County Level of Analysis

This study selected counties as the unit of analysis. Political and administrative priorities dictated this choice, although data availability and reliability were also important. National and state agencies most often report data at the county level. The key variables in this study (arrest, mortality, hospital discharge, and treatment admission statistics) are reported at the county level. An important exception is the National Survey of Drug Use and Health's (NSDUH), which reports its substate estimates of unmet treatment need at the regional level. In Maryland, four of the seven NSDUH regions are Baltimore City (651,154 in 2000) and the three largest counties: Anne Arundel (489,656), Montgomery (873,341), and Prince George's (801,515). The remaining three NSDUH regions in Maryland contain multiple counties. The primary danger of using individual counties is the population size of the smallest counties, such as Kent (19,197), Somerset (24,747), and Garrett (29,772). For some indicators, such as surveys and drug mortality statistics, annual estimates for these small populations may lack adequate reliability. Consequently, the study used five years of data in an effort to achieve acceptably reliable county estimates. In some states, especially in the west, the smallest counties must be combined into regions to achieve acceptable reliability for the selected indicators, even when using five years of data. The drug mortality rates are very low in rural counties, and many counties in states such as Montana have no drug deaths in a five-year period. In Maryland, analysis indicated that five-year county-level rates are highly reliable because the smallest counties are not too small, the state's substance abuse indicator data are high in quality, and both the state's alcohol and drug abuse problems are fairly prevalent.

Data Sources

Table 1 describes the study's key sources of data for the need indexes and treatment utilization; Table 7 in Appendix B describes the sources for the variables used in the construct validation analysis.

Population Data. The study used county population projections for each of the five years. The Maryland Department of Planning provided the projections to the study. Using these projections rather than the 2000 census estimates should increase the validity of the study's population rates. The projection for 2000 differs from the census estimate because the two refer to slightly different dates. The indicator variables are mean annual rates per 100,000 total population created by summing five years of the substance abuse indicator counts and dividing the counts by the sum of the five years of the county's population projections. Technically speaking, these rates are known as "crude" rates rather than age-specific or age-adjusted rates. Crude rates are used in the assessment of treatment needs because they reflect the size and rates of disease of the at-risk segments of the population as well the segments that are not at-risk.

Table 1. Data Sources for Indicators

Data	Unit	Years	Source of Data
Population	County	2001-2005 projections	United States Census Bureau, Population Division, release date March 22, 2007. Provided by Planning Data Services of the Maryland Department of Planning
Mortality	County	2001-2005	Maryland Department of Health and Mental Hygiene (DHMH), Vital Statistics Administration (VSA)
Hospital Discharges	County	2001-2005	Maryland Health Services Cost Review Commission (HSCRC)
Arrests	County	2001-2005	Maryland State Police (MSP), Uniform Crime Reporting (UCR) Program, English (US) Central Records Division; Uniform Crime Reports, Federal Bureau of Investigation; Inter-University Consortium of Political and Social Research (ICPSR), University of Michigan (for coverage indicators only)
Treatment Admissions	County	2001-2005	Maryland Department of Health and Mental Hygiene, Alcohol and Drug Abuse Administration (ADAA)

Mortality Data. The Vital Statistics Administration of the Maryland Department of Health and Mental Hygiene supplied the study's mortality data. The analysis focused on the 4,258 decedents in 2001-2005 who had an underlying or contributing diagnosis of explicit-mention drug or alcohol related diseases, including poisoning (see discussion of diagnostic codes in the next section and in Appendix A). The data excluded Maryland residents who died in other states, residents of other states who died in Maryland, and decedents for which a county of residence was missing on the death certificate.

Hospital Discharge Data. The Maryland Health Services Cost Review Commission made hospital discharge statistics available for analysis. The Commission collects and compiles data on Maryland's hospital discharges. For each discharge, the database contained information on primary and secondary diagnostic codes for the medical reason for admission, procedure codes for treatment provided to the patient, a Diagnostic Related Group (DRG) code, and a code for the patient's county of residence. A DRG is a classification of hospital patients at admission who could be expected to use similar levels of hospital resources (e.g., average length of stay); the codes were originally designed for utilization review and cost containment. Based on the DRG and procedure codes, the study divided the discharges into patients admitted to the hospital specifically to receive treatment (e.g., detoxification) for drug or alcohol abuse or dependence, and patients admitted to the hospital for treatment of a medical complication or condition stemming from excessive substance use (such as treatment of alcohol cirrhosis of the liver or a drug overdose). The study team removed discharge data for non-residents of Maryland and patients for whom a county of residence was missing. In the five years of data, there were 248,043 hospital discharges with a relevant explicit-mention drug or alcohol diagnosis, excluding persons who entered the hospital to obtain substance abuse treatment.

Arrest Data. The Maryland State Police's (MSP) Uniform Crime Reporting (UCR) Program provided the study with arrest data for drug- and alcohol-related crimes (drug possession and sales; driving under the influence/driving while intoxicated, liquor law violations, and disorderly conduct). The study team also reviewed related coverage (completeness) statistics available from the Inter-University Consortium of Political and Social Research (ICPSR), University of Michigan. Arrests are recorded in the county where they occur rather than the arrestee's county of residence. From 2001 to 2005, there were 434,665 drug and alcohol arrests in Maryland. The study also used arrest data on other crimes indirectly associated with substance use such as robbery and prostitution in the study's construct validation process (see Appendix B).

Treatment Admissions. The study's treatment admission data came from Maryland's Alcohol and Drug Abuse Administration (ADAA). They consisted of publicly-funded and privately-funded treatment admissions by drugs, alcohol, and substance abuse for 2001-2005. Publicly and privately funded were defined by the state's treatment admission database procedures. Agencies that received funds from ADAA provide the state with data on all admissions, even those paid entirely by out-of-pocket funds, health insurance, or other funding sources. Those admissions were all defined as publicly funded. This definition leads to an overestimate of the number of admissions actually funded partly or wholly by the state. The state also collects data from facilities that do not receive any funding from ADAA, and those data were defined as privately funded.

Maryland allocates public funding to counties in the form of slots. A treatment "slot" is a generic measure of capacity, of which a "bed" in a hospital or residential program is a special case. In 2008, there were 21,075 slots allocated to counties and 466 slots that were allocated statewide rather than to specific counties. The statewide slots were mostly for Level III clinically-managed residential and medically-monitored inpatient (hospital-based) treatment. According to state officials, the funds allocated to a county sometimes go to agencies outside of the county to pay for treatment delivered in other counties or to residents of other counties. Treatment admissions data have information on the residence of the client regardless of where he or she received the treatment or to which county the funds were allocated. Consequently, the study focused on treatment admissions rather than slot allocations. In 2001-2005, there were 354,973 treatment admissions for substance abuse disorders in Maryland. When admitting clients to treatment, programs obtained information on the primary, secondary, and tertiary substance of abuse. Our previous experience conducting substance abuse needs assessments in other states and nationwide showed that using the primary substance, rather than all three, resulted in measures with greater validity when focusing on drug and alcohol admissions separately. Using all three of the reported substances tends to overweight the alcohol measure with persons who are primarily drug addicts and have a secondary alcohol problem.

Two types of admissions were excluded from analyses in this study. Because the study's focus was on county-level analysis, we did not analyze the treatment admissions of clients who lived out of state (approximately 3,000 admissions per year) or whose county of residence was missing from the database. We also did not include admissions of non-abusing family members of substance abusers (approximately 1,000 per year). There were simply not enough cases of this type to warrant the adjustments we would have had to make to model such cases. For example, it would not have been possible to assign these cases unambiguously to the drug or alcohol need indexes.

Aggregate Level Statistics, Not Individual Level. Readers should recognize that while these data are based on individuals, our study used them in aggregate rates reflecting the characteristics of counties, not individual persons. Unlike a register that seeks to unduplicate multiple mentions to develop a count of the number of people with a substance use disorder, substance abuse indicators are conceived of as multiple alternative measurements of the same underlying phenomenon. Individuals may be represented in several indicators. For example, in the five year period many substance abusers are arrested, hospitalized, admitted to treatment, and die. And they may be represented more than once in each rate, except of course mortality. The study assumed that representation in multiple indicators and multiple times in one indicator reflects the severity of his or her substance abuse problem, which in turn is the purpose of the need index at the county level. Unlike an epidemiologist interested in estimating an incidence or prevalence rate, a treatment planner is concerned with how much service must be funded to meet the needs of substance abusers in a county.

Selection of Need Indicators, Treatment Measures, and Validators

Commentators on past needs assessment studies have sometimes questioned use of one or more of the indicators. It is important to recognize that no measure in this field or any other is perfect. Twenty years of research on the substance abuse indicators that we have selected for the present study have shown that these measures meet a series of rigorous scientific criteria. Many of the concerns about them were unsubstantiated by research employing standard reliability and validity assessment methods.

This section explains our indicator selection criteria based on our previous research (Breer et al. 1996; McAuliffe 2004, 2005; McAuliffe et al. 1986, 1991, 1999, 2000, 2002a, 2003; McAuliffe and Dunn 2004). The study assumed that a drug or alcohol user needed substance abuse treatment because he or she had severe symptoms of drug or alcohol abuse or dependence for a substantial period (not mild or transient), could not quit or regain control of use on his or her own despite serious attempts, and was 1) at imminent risk of or had already suffered clinically significant medical or psychiatric consequences of substance use, including disability or impairment, 2) was a danger or had caused harm to him- or herself or others due to substance use, or 3) was committing serious substance-related crimes (Aoun et al. 2004; Joska and Flisher 2005; McAuliffe and Dunn 2004). In the indexes, medical and psychiatric consequences were measured primarily by hospital discharges, danger to self or others was measured principally by mortality and hospital discharge statistics, and crimes were measured by arrest statistics. We constructed the Alcohol Need Index (ANI), Drug Need Index (DNI), and Substance Abuse Need Index (SNI) in accordance with this definition and empirical evidence of the indicators' validity (McAuliffe 2004, 2005; McAuliffe et al. 1999, 2000, 2002a, 2003; McAuliffe and Dunn 2004). Although based on the same conceptions, the Maryland versions of the indexes differed slightly from the indexes previously developed by the study team for other states (e.g., Rhode Island, Colorado, Massachusetts, North Dakota, Alaska, and Montana) and for the country as a whole. All of the state indexes included hospital discharge or claims data, but the national indexes did not because public use hospital discharge data are not yet available in all 50 states (in Alaska, for instance). We defined Maryland's alcohol arrest indicator somewhat differently from alcohol arrest measures used in other states. The differences reflected data availability in some states, variations in the results of state-level data analyses, and differing state laws (e.g., with regard to drunkenness arrests).

An indicator of treatment need and utilization had to meet several criteria. It had to cover all counties, include separate information on both alcohol and drugs, and have a direct connection with drug or alcohol use. Measures covering both drugs and alcohol are required for an index of substance use. They allow a natural weighting of the two categories of substances in the final summary measure of substance abuse treatment need. Investigators need not develop an artificial weighting of drug and alcohol indicators. For example, the substance abuse mortality indicator reflects how many deaths are actually caused by alcohol, drugs, or both. A natural weighting avoids inevitable debates about the relative importance of drug and alcohol problems. If a series of unrelated drug indicators and alcohol indicators were combined, difficult questions would immediately arise when determining how many of each type, drug or alcohol, should be included, and whether specific drug and alcohol indicators are equivalent. The study assumed equivalence of the importance of alcohol or drug consequences and their implications for the likelihood of needing and seeking treatment. A drug death is equivalent in importance to an alcohol death with regard to their implications for the need for treatment. A hospital discharge following treatment for a drug overdose is equal to a discharge following treatment for an alcohol overdose. It is also noteworthy that there are relatively few direct indicators of alcohol or drug use disorders that have no counterparts. So, this criterion does not result in loss of many obvious indicators of substance abuse.

To the extent possible, the components of the need indexes should be direct indicators of substance use disorders, what are commonly known as "explicit-mention" indicators. Another way of referring to these measures is with regard to their "alcohol attributed fraction" or "drug attributed fraction." Explicit mention measures are assumed to have 100% attributed fractions. Focus on this type of measure is the hallmark of the substance abuse indicator approach. The primary attraction of explicit-mention measures is that their link to drugs or alcohol is established during the original data collection or coding (such as, death due to opiate overdose, drunk-driving arrest, discharge diagnosis of alcohol cirrhosis, and primary admission to treatment for alcohol problems). This connection removes any ambiguity as to whether the events were caused by alcohol or drugs versus some other factor. That is, explicit mention indicators have strong "face validity." The feature contributes substantially to the acceptance of the index by the lay public as well as by substance abuse researchers and clinicians. Moreover, our research, described below, found that explicit-mention measures had greater empirical validity.

The components of the Maryland ANI were mean rates per 100,000 residents of alcohol mortality, alcohol-related hospital discharges, and alcohol-defined arrests (driving under the influence/while intoxicated, liquor law violations, and disorderly conduct). The Maryland DNI had parallel components: drug mortality, drug-related hospital discharges, and drug-defined arrests (possession and sales). The alcohol mortality cases were coded with explicit-mention alcohol diagnoses according to the *International Classification of Diseases*, 9th and 10th editions (ICD-9 and ICD-10) (e.g., McAuliffe et al. 1999, 2000, 2004; Stinson and Nephew 1996; Stinson et al. 1994). Explicit-mention alcohol diagnoses were alcohol dependence, nondependent abuse of alcohol (harmful use and intoxication), alcohol psychoses (withdrawal state, psychotic disorders, Kosakoff's psychosis), accidental ethyl alcohol beverage poisoning, alcohol cirrhosis of the liver, alcohol pancreatitis, alcohol cardiomyopathy, alcohol polyneuropathy, alcoholic gastritis, alcohol fatty liver, acute alcohol hepatitis, excess blood level of alcohol, and fetal alcohol syndrome (see Appendix A for the relevant ICD-9 and ICD-10 codes). The key element of these explicit-mention alcohol diagnoses is that the connection with alcohol in every case was made by the medical examiner. That is, 100% of the deaths with these diagnoses were attributable to the effects of alcohol.

In order to test the validity of explicit mention alcohol mortality indicators, we conducted a study using data from the National Institute on Alcohol Abuse and Alcoholism (Stinson et al. 1994). The study included four measures: 1) alcohol mortality rates with explicit mention (100% alcohol attributed fractions), 2) alcohol mortality due to diseases having lower alcohol attributed fractions, 3) alcohol mortality due to injuries having lower alcohol attributed fractions, and 4) total alcohol mortality that was the sum of the first three measures. We found that explicit mention measures correlated more positively than any of the other three measures with rates of alcohol treatment admissions and fetal alcohol syndrome. We concluded that explicit mention mortality measures were more valid than those which included deaths with less than 100% alcohol attributed fractions. Inclusion of deaths that only partly stemmed from alcohol appears to introduce an excess of irrelevant variance, and may inadvertently turn the mortality index into a measure of something other than alcoholism (e.g., poor general health). For instance, a small proportion of deaths due to heart disease is associated with alcohol use, but inclusion of even a small percentage of heart disease mortality in the alcohol need index would be overwhelming because there are so many deaths due to heart disease. Inclusion of heart disease as a measure of alcoholism implicitly assumes that the proportion of heart disease deaths due to alcohol is the same in all counties, and the variance of alcoholism is reflected by the number of heart disease deaths. However, the proportion of heart disease deaths due to alcohol may be much higher in counties with high rates of alcoholism than counties with low rates of alcoholism. The number of heart disease deaths would therefore lead to an exaggerated expectation of the number of alcohol related deaths in low rate areas. That would not be so for deaths with an explicit mention of alcohol.

By using five years of mortality data in county populations of sufficient size and combining multiple alcohol or drug diagnoses, we found that substance mortality rate indicators in other states had ample stability and reliability (McAuliffe 2005).

Hospital discharge statistics are particularly useful indicators because they are more numerous than mortality statistics. Hospital discharge rates are more likely than mortality statistics to reflect substance use disorders in young persons with serious but not necessarily the most advanced drug or alcohol problems. Hospital discharge data for all years were coded using the clinical modification of the International Classification of Diseases, 9th revision, (ICD-9-CM) codes. The ICD-9-CM codes were for essentially the same explicit-mention diagnoses used for the mortality measures. To obtain a measure of treatment need that is independent of treatment admissions, the hospital discharge variables eliminated people admitted to the hospital specifically to obtain substance abuse treatment, as measured by the Diagnostic Related Group (DRG) coding or by an ICD-9-CM procedure code for substance abuse counseling or detoxification in the discharge record. Diagnostic categories for drug mortality and hospital discharges indicators included drug dependence, nondependent drug abuse (intoxication and harmful use in ICD-10 for mortality), drug psychoses, and accidental drug poisoning (overdose). In the Maryland SNI, the mortality and hospital discharge cases that had both alcohol and drug diagnoses were not double counted. Therefore, the SNI is not equal to the sum of the DNI and ANI. Drug and alcohol arrest rates do not overlap in this way because Uniform Crime Report (UCR) rules assign each arrest to only one violation, the most serious. By the UCR rules, drug arrests are more serious than alcohol arrests.

We assumed that a person who was diagnosed in a hospital or by a medical examiner as having drug or alcohol dependence, non-dependent abuse, overdose, or disease caused by substance use needed treatment in accordance with the study's definition. Having a substance use disorder and severe medical complications of alcohol or drug use are primary medical necessity criteria for substance abuse treatment according to the utilization review criteria of the American Society of Addiction Medicine (ASAM) (Hoffmann et al. 1991; Mee-Lee et al. 2001). Research has shown that drug and alcohol mortality rates in states, towns, and large metropolitan areas were reliable and empirically related to drug and alcohol treatment utilization (Ford & Schmittdiel 1983; Person, Retka & Woodward 1976; Woodward, Retka & Ng 1984; McAuliffe et al. 1999, 2000, 2003; McAuliffe and Dunn 2004). Studies of substate area substance abuse indicators in Massachusetts, Rhode Island, North Dakota, and Colorado have found that hospital discharge and claim statistics were positively and substantially correlated with drug and alcohol arrest and mortality indicators as well as with substance abuse treatment admission rates (McAuliffe et al. 1986, 2001a, b, 2002).

Based on a substantial body of recent research, we assumed that people arrested for drug possession or sales, driving under the influence or when intoxicated, liquor law violations, and disorderly conduct were likely to have been under the influence of alcohol or drugs, had a substance use disorder, be a risk to themselves and others, and commit substance related violent and property crimes. Arrest measures cover a key part of the domain of treatment need. Criminal justice agencies account for the largest percentage of substance abuse treatment referrals nationwide (38% in the 2006 TEDS public use admissions database). When compared to mortality and hospital discharge statistics, arrest statistics may be expected to provide better coverage of the criminal-justice segment of the substance abuser population. Arrest statistics also provide greater coverage of youth. McAuliffe et al.'s (2000) qualitative inspection of liquor board websites suggested that the most common liquor law offense was selling alcohol to minors or intoxicated persons of any age. Other violations include possession of alcohol by a minor, having a fake ID, or having someone else's identification card. Nationwide, the 25 counties with the highest rates of liquor law violations contained resorts (15 counties) and large university or college campuses (10). Among 2,689 counties with at least one liquor law violation arrest between 1993 and 1998, 21% of the arrestees were adolescents. Although disorderly conduct arrests may not always involve alcohol, the Department of Justice's Uniform Crime Reports include disorderly conduct as an alcohol-related offense, suggesting that alcohol is a factor in a large proportion of these arrests (FBI 1992, p.23). In states that have decriminalized drunkenness, persons arrested for misbehaviors associated with alcohol intoxication are often charged with disorderly conduct, which includes "drunk and disorderly." We therefore made an exception for this type of arrest because of its importance in urban areas, as contrasted with DUI and liquor law violation arrests that tend to occur most often in rural and suburban areas.

While not all drug or alcohol arrestees have a substance use disorder, their rates are far higher than the general public's. Being arrested repeatedly as a result of drug or alcohol use satisfies the diagnostic criteria for substance abuse according to the American Psychiatric Association (1994). Studies of arrestees for drug possession in 23 cities found that 86% of males and 84% of females tested positive for drug use (Schlaffer 1997; also see Craddock, Collins & Timrots 1994). The figures for drug sale arrestees were 76% and 80% for males and females respectively. Despite high levels of underreporting by arrestees, Yacoubian (2003) found that 37% of 1,436 arrestees in New York had a drug abuse or dependence diagnosis, and 19% had an alcohol abuse or dependence diagnosis. Studies of DUI arrestees have found them to have high rates of problem drinking and severe consequences of drinking (Borges & Hansen 1993; Centers for Disease Control [CDC] 1994; Chalmers, Olendick & Stein 1993; Kennedy, Isaac & Graham1996; Lapham et al. 2001; Mancino et al. 1996; Vingilis 1983; Yu & Williford 1993). In studies of substance use disorders among prisoner populations, large percentages have a history of a drug or alcohol use disorder, and many of the prisoners self-reported that they were under the influence of one or more substances at the time of the arrest that led to their imprisonment (McAuliffe et al. 2000, 2002c; McClelland et al. 2004; Fazel et al. 2006). In surveys of incarcerated prisoners in Rhode Island and Alaska, we found 80% of the adults and 60% of the adolescents had a past-year substance use disorder diagnosis (McAuliffe et al. 2000, 2002c).

Of course, it is the strong connection between the need for treatment and substance related crimes that accounts for much of the public's support for public funding and insurance mandates for substance use treatment. The relatively recent growth of drug courts and the movement to provide treatment as an alternative to arrest and incarceration are likely to be key parts of increases in demand for public treatment services in the future. It seems essential therefore to include substance abuse arrests as part of the system of monitoring the adequacy of substance treatment services.

Ecological studies at varying levels of aggregation and in several countries have reported evidence of the validity of substance abuse arrest rates as geographic indicators of substance abuse treatment need (Bauer & Olson 2003; Beenstock 1995; Chong 1998; Ford & Schmittdiel 1983; McAuliffe et al. 1986, 1999, 2000, 2002, 2003; Simeone, Frank & Aryan 1993; Woodward et al. 1984). These findings are not consistent with concerns that drug and alcohol arrest rates are more likely to reflect police activity levels due to factors other than the prevalence of drug and alcohol problems (Defleur 1975).

As with mortality and hospital discharge measures, we did not include arrests that are merely correlated with substance use in many locales. For example, inclusion of murder, theft, robbery, vagrancy, and similar crimes in the need index would risk inadvertently creating a measure of crime rather than a measure of substance abuse. Also, the association between these crimes and substance use disorders is not uniform among areas. For example, while murders may be strongly associated with heroin and cocaine abuse in Baltimore City, murders may be less likely to be associated with drug abuse in counties where drug abuse is less common. This form of bias would not occur in the case of explicit-mention drug arrests for possession or sales. We made disorderly conduct arrests a special exception to this criterion because in many states public drunkenness is an explicit component of disorderly conduct.

We selected treatment admissions by primary substance and residential location of the client as our measure of services provided. Treatment admissions rates have face validity as measures of treatment utilization as well as empirical reliability and convergent validity for this purpose (McAuliffe 2005; McAuliffe et al. 1986, 1999, 2000, 2002, 2003). Treatment admission statistics are of course not perfect. Our research on federal treatment admission statistics identified many data problems that required correction or imputation. We also had a data error in the Maryland State admissions data for Howard County, and the definitions utilized by Maryland with regard to public versus private treatment were not ideal for the present purpose. They tended to overestimate the amount of public services and underestimate the proportion of privately funded services.

Table 7 in Appendix B describes the measures we called "validators." These measures are theoretically related to drugs or alcohol. While sometimes used by other authors in drug and alcohol epidemiological studies, the measures were not used as need indicators in this study because they failed to meet all of our selection criteria. For example, a measure may cover alcohol but lacks a drug counterpart (such as, fatal accidents in which the driver had a blood alcohol level of .10 or greater). A validator may not be an explicit-mention measure theoretically linked to alcohol or drugs 100% of the time, but it had a strong link to drugs or alcohol (such as, hepatitis B and C, HIV/AIDS, and arrest for prostitution). A variable that otherwise would qualify as a need indicator but does not have complete coverage of all counties could be used as a validator, because the construct validation analysis focuses on bivariate correlations among indicators and does not require complete coverage. The analysis used pair-wise deletion of cases when data were missing from either variable.

Especially important variables used as validators in this study are the estimates of drug, alcohol, and substance use disorders for substate regions based on statistical models using NSDUH data for 2002-2004 and 2005-2006 (Office of Applied Studies 2006, 2007). The 2002-2004 NSDUH regional estimates of the percentage of residents 12 or older with substance use disorders came from a report published by the Office of Applied Studies (2006). Maryland's total interview sample size for the three years was 2,683, including 376 cases from Baltimore City, 453 from Montgomery County, 396 from Prince George's County, and 232 from Anne Arundel County. The Office of Applied Studies (2007) supplied us with pre-publication regional estimates from an analysis of 2005-2006 NSDUH data for Maryland. NSDUH estimates do not qualify as need indicators at the county level because the estimates are regional, encompassing multiple counties in three of Maryland's seven NSDUH regions. Also, Anne Arundel County was not covered for alcohol use disorders in the 2005-2006 regional estimates, and consequently there were no substance use disorder estimates for that county in 2005-2006. Another important limitation of the NSDUH estimates is that the statistical model used to generate the estimates includes measures of drug and alcohol treatment utilization from the Uniform Facility Data Set (Office of Applied Studies 2006, p. B4). The inclusion of treatment received in the statistical model means that the estimates are not independent of services delivered, and so cannot be used to test whether the amount of services provided in a county is commensurate with the level of need measured by other indicators. The primary purpose of developing a need index is to obtain a measure that is separate from manifest demand for treatment (admissions) in the belief that there is latent demand for treatment not being met by existing treatment services. Finally, the NSDUH's estimates of unmet need assume that any respondent who received treatment needed it even if he or she failed to meet the NSDUH's diagnostic criteria. Despite their limitations as a need indicator in our indexes, the NSDUH substate alcohol and drug use disorder estimates can be used as validators in the construct validation of the drug and alcohol need indexes (Table 4). States such as Maryland often apply the multi-county regional estimates uniformly to each county in the region to generate county values, and we adopted that strategy when using the NSDUH drug and alcohol use disorder estimates in our construct validation of Maryland's DNI and ANI.

Data Processing

An important study objective was to evaluate the adequacy of the indicator data in Maryland. As a result of conducting substance abuse indicator studies in many states, we know that states vary in the quality of their indicator data. These variations can undermine the application of measurement methods that would otherwise generate indicators with substantial validity. Our study team carefully reviewed the raw counts of each variable for evidence of missing data and unlikely annual value changes (e.g., large increases or decreases from one year to the next that were inconsistent with prior years or changes in the other counties). Due to annual variations in the state budget, the number of treatment admissions in virtually all counties can be expected to increase or decrease a small amount in concert from year to year. When there were missing or questionable values for a specific indicator, the staff called the source agency for clarification or verification that the figures were accurate. In many cases, large variations in one county are due to the closing of a facility or a spike in the substance abuse problem, but sometimes the changes reflect data errors of which county officials are aware. Whenever incorrect data were discovered, we sought corrected information from the relevant agency. If one instance when no corrected data were available for a validator, we replaced the missing observations with values imputed by regression analysis from the rates in the other years.

Reliability and Validity Assessment

Both measurement reliability and validity are quantitative concepts, varying theoretically from 0.00 to 1.00. In this regard, the scientific versions of these concepts contrast with laymen's usage, which is qualitative. Non-scientists typically speak of whether a measure is reliable or unreliable, or valid or invalid, rather than the extent of the measure's reliability or validity. Reliability is the proportion of a measure's variance that is reproducible (nonrandom), while validity is the proportion that reflects the concept of interest. Even when a measure meets scientific standards regarding the extent of its reliability or validity, there may be specific instances of the measure's use that reflect random or systematic error. For example, a measure that meets the standard of 90% reliable variance includes 10% error variance. Consequently, anecdotes that describe instances in which the statistics in question are apparently in error are insufficient for establishing that the total variance of the measures falls below the scientific standard.

To evaluate these measurement properties, our study used classical psychometric methods (Nunnally and Bernstein 1994). We assessed reliability and validity at two levels: individual indicators and the composite indexes. Using component indicators with substantial reliability and validity helps to create indexes with acceptable levels of reliability and validity, but combining reliable and valid items does not necessarily result in a highly reliable or valid composite index. The composite index may not contain all of the necessary components of the domain of the concept being measured, even though the ones it contains are substantially reliable and valid. The reliability and validity of the index components and the composite index are evaluated separately.

Reliability. The study evaluated the reliability of the 2001-2005 indicator rates and composite index scores using Cronbach's (1951) alpha. Alpha is an internal-consistency measure of reliability reflecting the average correlation among the components and the number of components. In this measure, the higher the correlation among the rates from year to year and the larger the number of years included in the composite rate, the more reliable the rate will be. The components of the five-year indicator rates (such as the drug mortality rate for 2001-2005) were the five separate annual drug mortality rates. Alpha also measured the reliability of the composite DNI, ANI, and SNI index scores by analyzing correlations among the standardized mortality, arrest, and hospital discharge components of each index (e.g., drug mortality, drug arrest rate, and hospital discharge z-scores that make up the DNI).

Validity. The study assessed the convergent and discriminant validity of the need index components by analyzing a multitrait-multimethod correlation matrix (Campbell & Fiske 1959; Scherpenzeel & Saris 1997). This methodology depends on having at least two or more indicators of two or more concepts. In this study, the concepts were drug and alcohol treatment need, with the parallel multiple indicators for each index based on mortality, hospital discharge, and arrest rates. Convergent validity assumes that parallel measures of the same underlying concept should correlate positively with each other. In geographical analyses the correlations among the alternative indicators may be only moderate in size because different aspects of the concepts are evident to varying degrees in different locales. For example, if the drug problems in one area most often involve marijuana and in another area most often involve cocaine and opioids, drug mortality rates may be relatively insensitive to the drug problems in the first area compared to the problems in the second area. Other indicators, such as arrests, may be sensitive to the presence of marijuana, opioid, and cocaine problems. Still others, such as surveys, may be more sensitive to marijuana problems than to cocaine or opioid problems. Similarly, DUI arrests tend to be more common in rural areas, whereas drunk and disorderly arrests are more common in urban areas. Multiple indicators are used to compensate for these variations in the sensitivities of the particular indicators.

Discriminant validity assumes that measures of different concepts should correlate less well than measures of the same concept correlate. Some overlap between different concepts is possible that would result in a positive correlation between their measures. In this study, it was reasonable to expect some geographic overlap between drug and alcohol treatment need. We found it in our earlier indicator studies in Massachusetts and Rhode Island (McAuliffe et al. 2002b, 2005). The overlap may stem, for example, from people who suffer from both disorders and from people with alcohol problems and people with drug problems living in the same poor urban neighborhoods. But this overlap would not be as great as the overlap between alternative measures of the same concept, such as alcohol problems.

Obtaining discriminant validity can be a challenge when indicators of different concepts stem from the same measurement or data collection system (e.g., drug and alcohol mortality rates). A high level of correlation in such cases is assumed to reflect a "method effect," that is, covariation in the indicators is due to the measurement process itself rather than due to overlap in the concepts being measured. Different method effects may also overlap with each other to some degree (e.g., mortality and hospital discharge rates use the same diagnostic coding and therefore may have the same inherent bias to some degree). Measures that share neither the concept nor the method (such as drug mortality and alcohol arrests) should have the lowest correlations in the matrix.

All of the drug and alcohol need and treatment indicators (deaths, arrests, hospital discharges, and treatment admissions) were also included in an exploratory factor analysis to assess convergent and discriminant validity.

Index Construction.

A key feature of our approach to substance abuse measurement is using a composite index rather than a single indicator such as the total alcohol mortality measure used by the National Institute on Alcohol Abuse and Alcoholism (Stinson et al. 1994) or a series of individual indicators examined one at a time, as is typically used by Community Epidemiology Work Groups (1999) in Maryland and all other states. Our methodology assumes that an unweighted linear composite index (simple sum) will result in a more valid, reliable, and useful measure of need than would any single indicator or a profile of indicators. Linear composites (sum of the variables) average out some of the idiosyncrasies of the component variables, reducing random or systematic measurement error. The Substance Need Index (SNI) was constructed by summing unweighted standardized versions of the three substance abuse indicators and then scaling the result to be more easily interpreted by users.

Standardizing, by converting the rates to standard scores or Z-scores, where $Z_i = (X_i$ - Mean of $X_i)$/standard deviation of X_i, puts all variables into the same metric and eliminates the effects of different frequencies that are typical of indicators. Without standardizing, indicators with high frequency such as arrest or hospital-discharge rates, would greatly outweigh indicators with low frequency, such as mortality rates. Merely adding up deaths, arrests, and hospital discharges without converting them to Z-scores first would have implicitly made an arrest equal in importance to a death. After conversion, the equivalence between deaths and arrests has been adjusted for the mean number of each type of event and the degree to which the specific rates vary over the counties. In these data, a Z-score of 1.0 for the alcohol mortality rate in a county is equally extreme relative to the mean value as an alcohol hospital discharge rate that is almost 41 times as high. This ratio is not a moral judgment or a cost-benefit assessment. It merely reflects the extent to which the respective measures express the underlying severity of the substance abuse problem in each area.

An “effective weight” of an indicator in a composite index is the proportion of the index’s variance due to that indicator. The effective weights of index components in a nominally unweighted sum of standardized variables are each equal to 1.00 plus the sum of the correlations of the component with all of the other index components. Thus, components with the highest correlations with the other variables (i.e., the greatest convergent validity) are implicitly most heavily weighted in the index. In practice, the need indicators typically have approximately equal effective weights in the composite indexes. The effective weights in the Maryland indexes are described in this report.

We re-scaled the sum of Z-scores by linear transformation so that a hypothetical county with no drug or alcohol deaths, hospital discharges, or arrests would have a SNI score of zero, and a hypothetical county with all three of the highest observed values of the drug and alcohol mortality rate, hospital discharge rate, and arrest rate would have a SNI score of 100. In the future it might be possible for a county to have a score that exceeds 100 if rates go up and the index has not been rescaled. Because the need index scores reflect underlying rates per 100,000, they should be interpreted as measuring treatment needs adjusted for population size. Although the scale has a true zero and summed three ratio-scale variables, we assumed only that it approximated an interval scale level of measurement. Interpretation of the scores would be similar to the many other interval level measures found in daily life, such as the Fahrenheit scale of temperature or the Scholastic Aptitude Test (SAT).

The study constructed the Drug Need Index (DNI) and Alcohol Need Index (ANI) in a parallel fashion to the SNI. The Drug Need Index (DNI) combined drug mortality, hospital discharge, and arrest rates. After transforming these three rates into standard scores, the analysis summed them to create the unscaled version of the DNI, and then we scaled the values as described in the previous paragraph. Although usually no county has the highest mortality, hospital discharge, and arrest rates in a state, in Maryland the City of Baltimore had the highest rates for all three drug need indicators, and therefore its DNI score is 100. The ANI's three alcohol indicators were standardized rates of alcohol mortality, alcohol hospital discharges, and alcohol arrests (driving under the influence, liquor law violations, and disorderly conduct arrests).

The study assessed the ANI and DNI composite need indexes by a method known as construct validation (Cronbach & Meehl 1967; Bentler 1978; Woodward et al. 1984). Measurement experts use this validation method when there is no "gold standard," a widely accepted and thoroughly validated measure of the concept of interest. Construct validation is inferred from the behavior of the newly constructed measure, specifically whether its behavior in analyses is consistent with theoretical expectations regarding the concept being measured. Construct validation assumes that the index scores will correlate in accordance with theoretical propositions about the correlations between alcohol and drug treatment need and other concepts related to drug and alcohol treatment needs, including causes (such as poverty rates), correlates (like traffic fatalities that are not included in the alcohol mortality measure), and consequences (such as drug related contagious diseases such as IV-HIV/AIDS). As noted earlier, we called these variables "validators," even though none is considered a gold standard or to be even as valid as the newly constructed need indexes. McAuliffe (2005; McAuliffe and Dunn 2004; McAuliffe et al. 1999, 2000, 2003) has used this approach and terminology in other treatment needs assessment studies.

Assessing Treatment Gaps

The study measured the adequacy of county-specific substance abuse treatment admission rates by the direction and size of the residual values of a bivariate linear regression analysis (McAuliffe et al. 2002, 2003; McAuliffe and Dunn 2004). Regression analysis is a statistical curve-fitting methodology for summarizing the relationship between independent and dependent variables. In this instance, there was a single independent and a dependent variable and the relationship was summarized by a straight line. A straight line assumes that the average relationship between county treatment need and treatment admissions is constant along the entire range of experience. The independent variable in the regression equation was the SNI scores, while the dependent variable was total treatment admissions. Regression analysis assumes quantitative level of measurement or higher (ordinal, interval, or ratio) (Cohen and Cohen 1975, p. 9-10), and these two measures meet that requirement. We assumed that the index scores are interval level measures, while the treatment admission rates are ratio level measures. The regression model estimated the prevailing standard of care for the aggregate relationship between treatment need and service availability in the state. If the observed treatment admission rate was lower than the predicted treatment admission rate, the "residual" was negative. That would indicate that the treatment admission rate in the county was lower than the estimated county average for its level of need. We interpreted a negative residual value as a treatment gap.

The study performed a sensitivity analysis to determine the extent to which the estimates of the intercept and slope parameters were affected by an outlier (Baltimore City) and assuming that the intercept was at the origin. The regression was re-estimated with a trimmed sample from which the outlier had been removed, and another analysis assumed that the intercept was equal to zero. (See appendix C.)

To illustrate the treatment need index's possible use in service allocations, the study developed a plan for closing county treatment gaps. Evidence from previous surveys of state needs and services indicates that the absolute amount of unmet need throughout the state is so great that our plan reduced no county's services from current levels. We assumed the overall state treatment resources will increase over time. Our recommendations call for first increasing treatment resources in those counties whose treatment admissions are most below the amount that would be expected based on their needs. The study also assumes that the percentage of admissions in county facilities that receive funding from the state will remain constant in the immediate future.

RESULTS

Indicator Reliability

The five-year rates of drug, alcohol, and substance treatment need and admissions achieved a high level of reliability (last column in Table 2). The arrest data had a small number of observations that were sufficiently inconsistent from year to year to warrant further investigation. These inquiries did not result in the discovery of any significant data problems. Observations of drug and alcohol mortality were missing in two counties. A call to the relevant agency revealed that the missing observations should have been zeros, and the data were corrected. The indicators that were most frequent (the five-year rates of arrests, hospital discharges, and treatment admissions) were most reliable (.99 in every instance), while the five-year mortality rates based on far fewer cases (4,258 deaths) were somewhat less reliable but still had reliability coefficients ranging between .91 and .94, which were above the usual reliability standard of .90 or higher.

Descriptive Statistics

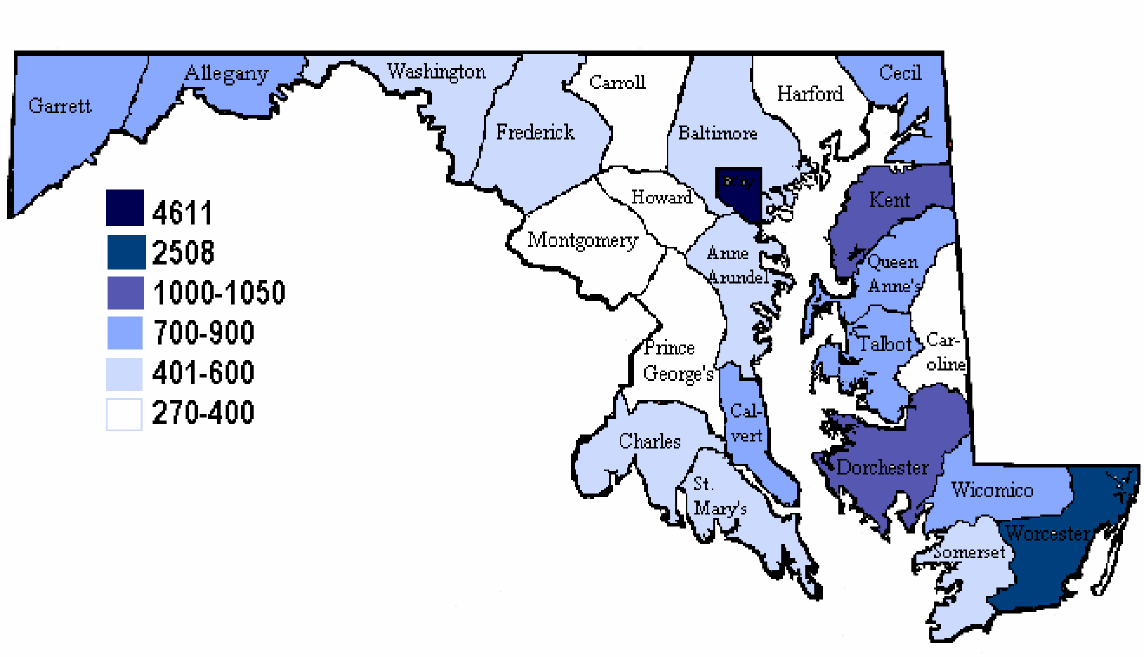
The statistics in Table 2 describe the prevalence of the study's key substance abuse indicators. As just noted, deaths per 100,000 were much less common than were rates of treatment admissions, arrests, or hospital discharges. The county rate of substance-related deaths per 100,000 each year on average over the period was 14.5, which was one hundredth the rate of treatment admissions. Substance abuse treatment admissions and arrests were approximately twice as prevalent as hospital discharges. Drug mortality was the only indicator for which there were counties (Garrett, Somerset, and Kent) with no cases in the five-year period.

Table 2. County Alcohol and Drug Need Indicators in Maryland, 2001-2005 (n=24)

Average Annual Rates per 100,000	Substance	Min	Max	Mean	Standard Deviation	Alpha Reliability
Mortality	Alcohol	5.1	32.6	12.3	5.9	0.91
	Drugs	0	16.3	2.5	3.2	0.91
	Both	5.9	47.3	14.5	8.3	0.94
Hospital Discharges	Alcohol	189.9	1,450.7	474.1	266.9	0.99
	Drugs	96.9	2,395.6	437.9	447.4	0.99
	Both	290.6	3,255.1	786.4	588.8	0.99
Arrests	Alcohol	364.8	4,608.2	1,047.5	837.1	0.99
	Drugs	272.1	4,610.7	849.5	916.6	0.99
	Both	673.1	7,116.5	1,897	1,415	0.99
Primary Treatment Admissions	Alcohol	217.9	1,351	670.0	276.6	0.99
	Drug	284.8	3,104.3	784.3	570.2	0.99
	Both	524.2	3,613.2	1,454.3	696.5	0.99

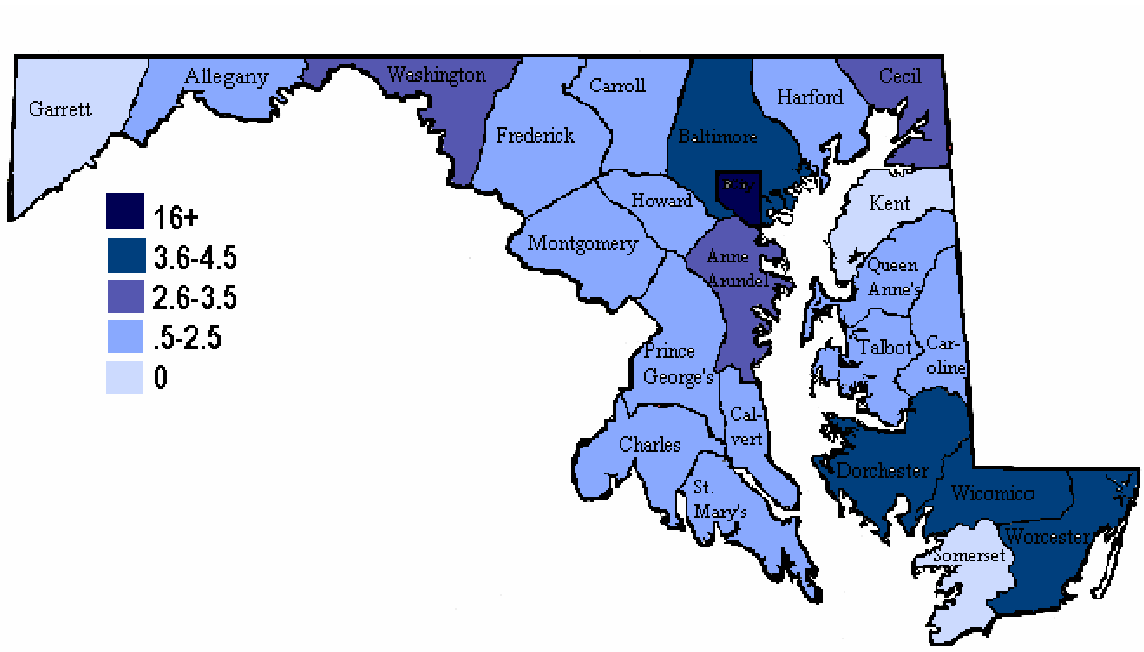
Comparing the drug and alcohol treatment need indicators (deaths, arrests, and hospital discharges) with their counterpart treatment services suggests a relative discrepancy with regard to alcohol versus drug treatment services relative to needs. Five times as many people died due to alcohol than drug use (12.3 versus 2.5 per 100,000), more people were arrested for an alcohol-related crime than drug-related crime (1,047.5 versus 849.5 arrests per 100,000), and more were discharged following hospitalization for an alcohol-related diagnosis than a drug-related diagnosis (474.1 versus 437.9 per 100,000). More than twice as many respondents reported having symptoms of an alcohol use disorder than symptoms of a drug use disorder in the NSDUH (7.1% versus 2.9% [not shown in Table 2]). By contrast, the mean drug treatment admissions exceeded the mean alcohol treatment admissions (784.3 versus 670.0 admissions per 100,000). McAuliffe and Dunn (2004) similarly found that alcohol need indicators exceeded drug need indicators at the national level, but there were slightly more primary admissions for drug than alcohol treatment (287,987 versus 282,537). McAuliffe (2005) and McAuliffe et al. (2002a) discovered a similar discrepancy between alcohol and drug mortality and hospital discharges versus treatment admissions at the intrastate level in Massachusetts and Rhode Island.

Figure 1: Drug-Related Arrest Rates per 100,000 Population 2001-2005



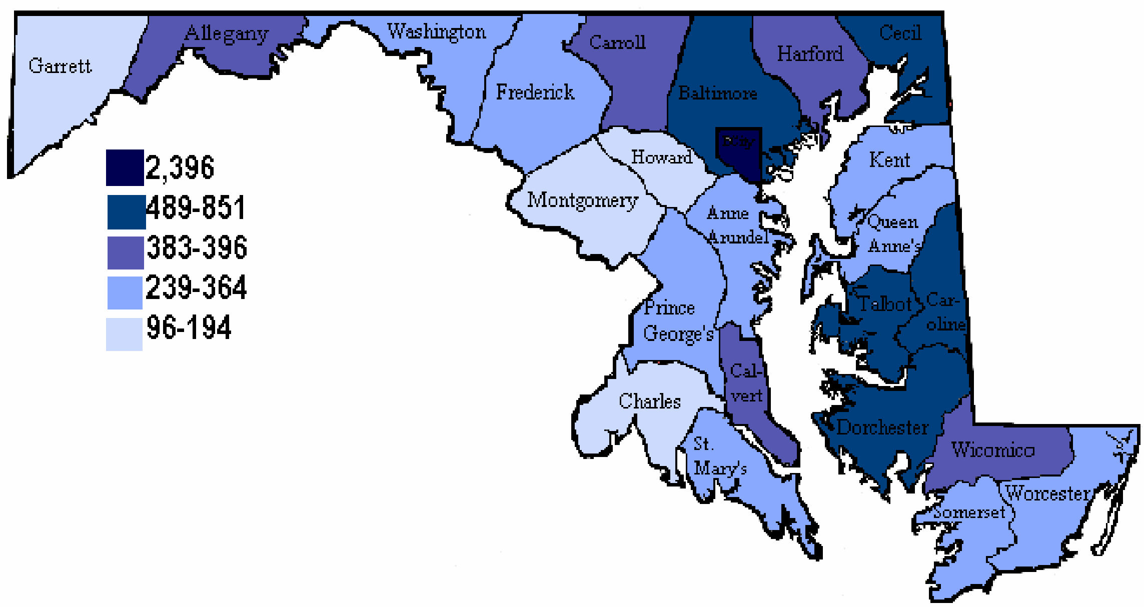
The drug abuse indicators had a wide range of rates over the 24 counties. Baltimore City's average annual drug arrest rate from 2001 to 2005 (4,611 per 100,000) was seventeen times higher than Montgomery County's rate (272 per 100,000) over the same period. In addition to Baltimore City, Worcester County's drug arrest rate (2,508 per 100,000) stood out from the rest. Even when these two "outliers" or extreme values were removed, county drug arrests rates varied substantially, with a four-fold difference between Kent County (1,043 per 100,000) and Montgomery County (Figure 1). Similar variations were evident for drug mortality rates (Figure 2), with Baltimore City's rate of 16.3 drug deaths per 100,000 residents being four times as great as the next highest rate (Baltimore County at 4.3 drug deaths per 100,000). As noted above, Kent, Somerset and Garrett Counties had no drug deaths between 2001 and 2005. All three had drug arrests, hospital discharges, and treatment admissions. Using Allegany County's rate (0.5) as the lowest non-zero drug mortality value, the ratio for the highest to the lowest non-zero county rate was 32 fold. The rates per 100,000 of hospital discharges with drug-related diagnoses (excluding patients admitted for drug treatment) between 2001 and 2005 ranged from a low of 96.9 (Garrett County) to a high of 2,395.6 (Baltimore City) (Figure 3). The highest rate was 24.7 times greater than the lowest. The most reliable measures of the size of variations among counties were the standard deviations in Table 2. In all cases, they were substantial in size compared to the mean values.

Figure 2: Drug Mortality Rates per 100,000 Population 2001-2005



These large inter-county variations in rates of drug deaths, hospital discharges, and arrests demonstrate that treatment needs vary considerably from county to county. There is no evidence that there is a constant percentage of every county's population with a drug use disorder. The underlying drug use disorder rate that causes deaths, arrests, and hospital discharges is highly variable from county to county and requires a parallel rate of drug use disorder treatment allocations. Accordingly, current drug treatment admission rates vary greatly from county to county. Residents of Baltimore City had the highest drug treatment admission rate (3,104 per 100,000), while Montgomery County had the lowest (284.8 per 100,000). Montgomery County had the second lowest drug hospital discharge rate (150.2 per 100,000) and the 5^{th} lowest drug mortality rate (1.0 per 100,000). The eleven-fold ratio of highest to lowest drug treatment admission rates is not quite as great as the ratios of the top to bottom rates for the three need indicators. Maps of the geographic distribution of the drug indicators showed that the highest rates other than Baltimore clustered on the Lower Eastern Shore (Figures 1, 2, and 3). Those same counties consistently had the highest alcohol indicator rates as well (Figures 4, 5 and 6).

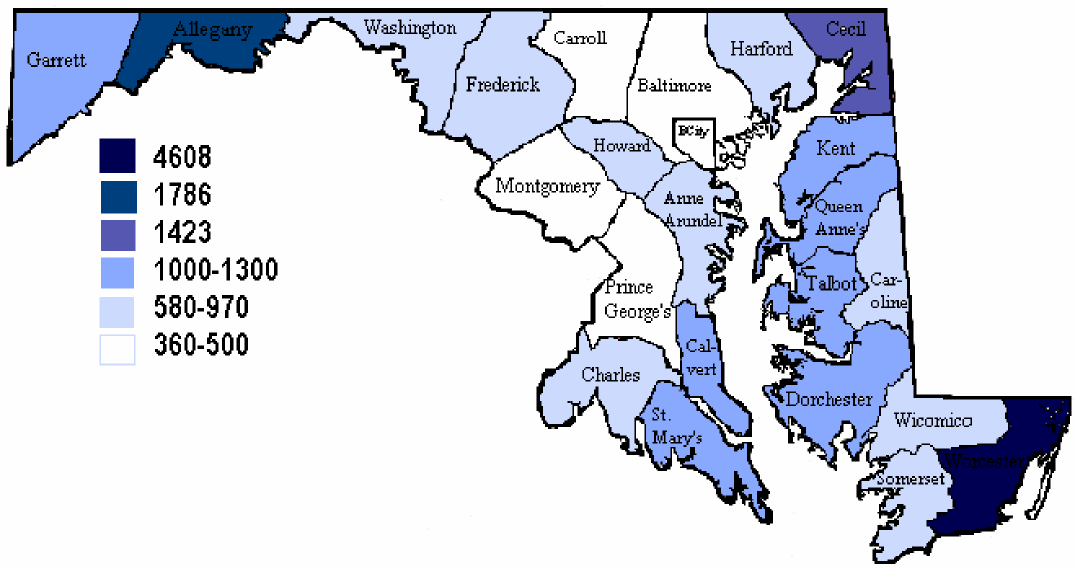
Figure 3: Drug-Related Hospital Discharge Rates per 100,000 Population 2001-2005



The alcohol abuse need and treatment indicators varied substantially over the 24 counties, and one county (either Baltimore City or Worcester County) stood out from the rest on each of the measures. The composite alcohol arrest rate for 2001 to 2005 combined arrests for driving under the influence (DUI) or driving while intoxicated (DWI), liquor law violations, and disorderly conduct. The highest alcohol arrest rate was in Worcester County (4,608 arrests per 100,000 residents), while the lowest rate was in Baltimore City (365 per 100,000). Worcester County's alcohol arrest rate was 2.5 times greater than the second highest rate in Allegany County (1,786 per 100,000) and 12.6 times greater than the lowest rate in Baltimore City (see Figure 4). Interestingly, while Baltimore City had the lowest alcohol arrest rate, its alcohol mortality and hospital discharge rates were by far the highest in the state (32.6 per 100,000 and 1,451 per 100,000 respectively). The lowest alcohol mortality rate in the state was in Howard County (5.10 per 100,000), which was one sixth as large as the rate in Baltimore City. The lowest alcohol hospital discharge rate was 190 per 100,000 in Montgomery County, one seventh as large as the rate in Baltimore City. The highest primary alcohol treatment admission rate was in Worcester County (1,351 per 100,000), while the lowest was in Prince George's County (217.9 per 100,000). The variations among the alcohol indicators were smaller than variations among the drug indicators.

When we combined the drug and alcohol data into substance abuse arrest, mortality, and hospital discharge rates, substantial inter-county variations were still evident (Table 2 and Appendix D). Worcester County's substance abuse arrest rate was an outlier, while Baltimore City's rates on all three substance abuse indicators were outliers. As is well known, outliers may have disproportionate effects on statistics such as correlations and regression equations. The effects were analyzed in Table 3 and in Appendix C. Even after the outliers were minimized, there was clear evidence that treatment resource allocation methods which assume that all counties have the same rate of substance abuse problems are inconsistent with the empirical evidence from a range of indicators directly related to substance abuse problems.

Figure 4: Alcohol-Related Arrest Rates per 100,000 Population 2001-2005

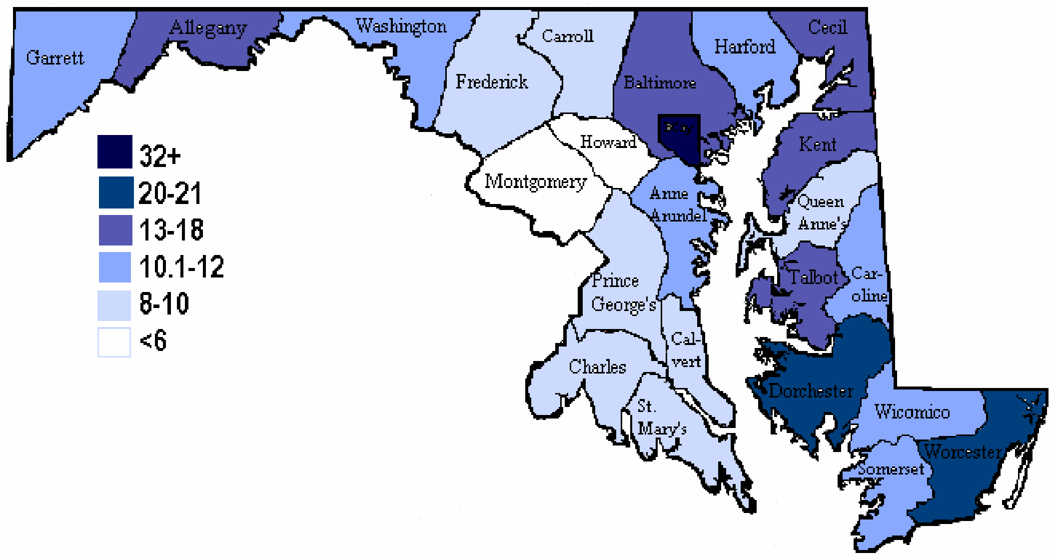


Convergent and Discriminant Validity of Components

There was evidence of convergent validity among the drug need indicators (see Table 3). The bold Pearson correlations among the three drug need indicators were .93, .86, and .83; all three were statistically significant.[2] The Pearson correlations between the three individual drug need indicators and drug treatment admission rates were also positive and substantial: drug mortality (.85), drug hospital discharges (.93), and drug arrests (.88).

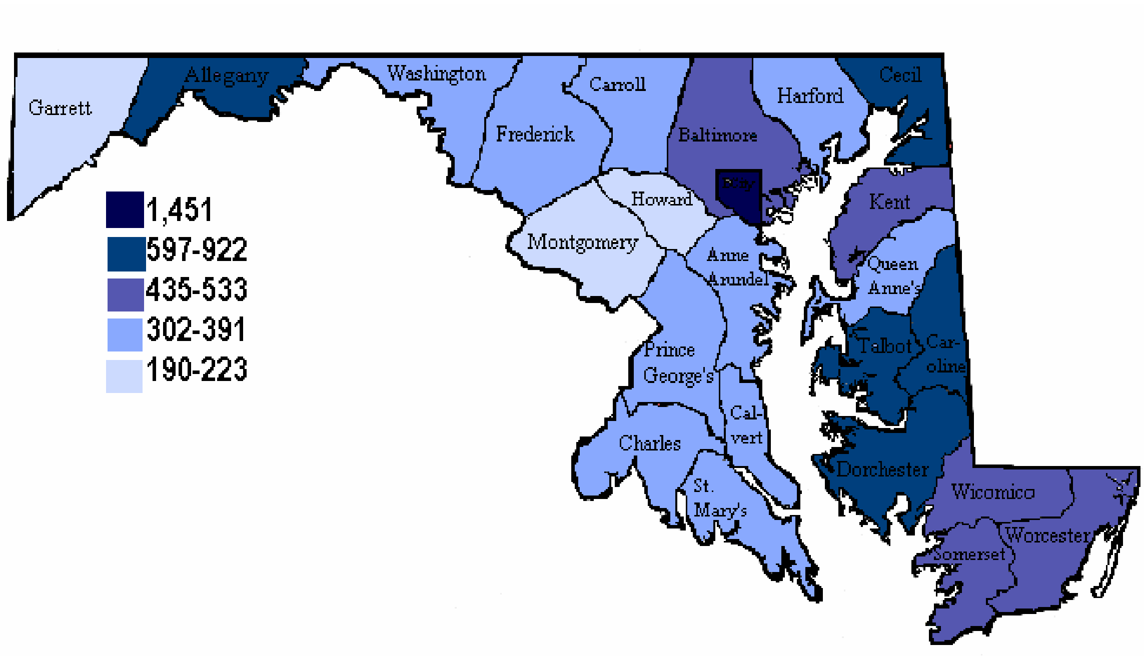
[2] Ordinarily, a significance test determines whether an observed sample correlation reflects a non-zero correlation if all cases in the population were measured. The interpretation of these statistical tests is complicated because the counties are not random samples but are the total population of Maryland counties. Consequently, the test is used in this study as a conservative benchmark against which readers may judge the potential stability of the relationships to the effects of random errors that might occur in the data collection process. The sample size of 24 is small, and the tests show that even moderate correlations might not be significant had the sample been drawn randomly from a hypothetical population of Maryland counties.

Figure 5: Alcohol Mortality Rates per 100,000 Population 2001-2005



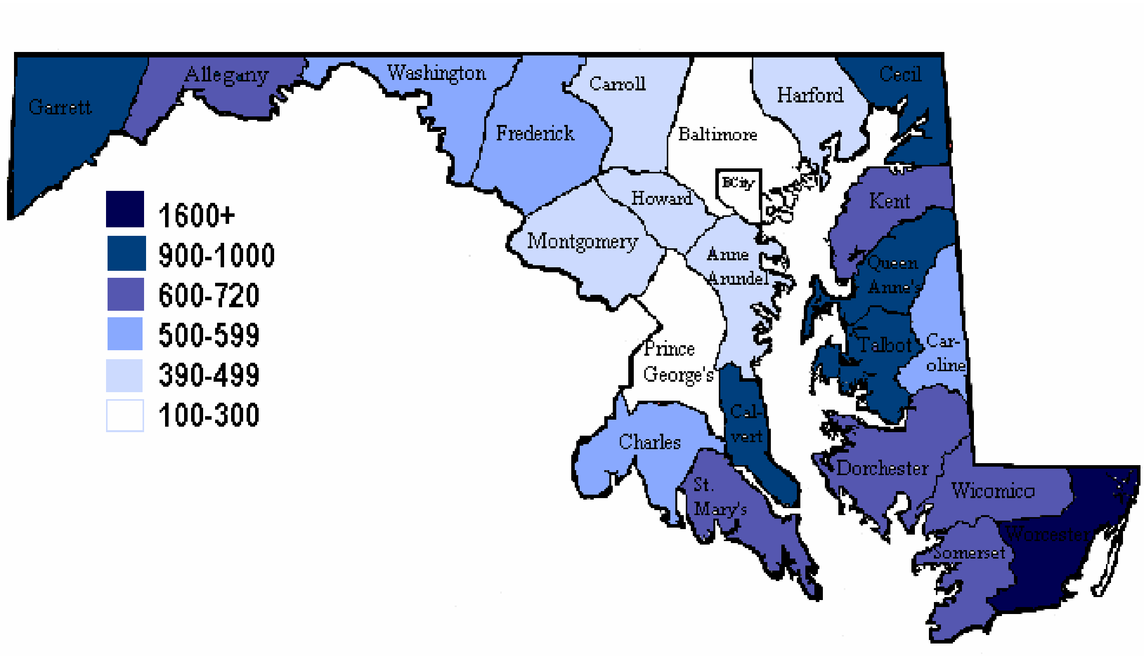
The evidence of convergent validity for the counterpart alcohol indicators was more complex (lower right quadrant of Table 3). The alcohol mortality rates and alcohol hospital discharge rates correlated .92 with each other, but neither of those two alcohol need indicators correlated significantly with the alcohol arrest rate (.30 and .01 respectively). By contrast, the correlation of alcohol arrest rates with alcohol admission rates was .67 ($p<.05$), much stronger than the correlations of the other two alcohol need indicators with primary alcohol treatment admissions (.30 for alcohol mortality and .16 for alcohol hospital discharges). It is also noteworthy that the correlations in Table 3 were similar to the findings for the same drug and alcohol indicators in Massachusetts (McAuliffe 2005) and similar to the results in Rhode Island except for the correlations with the alcohol arrest variable (McAuliffe et al. 2002a).

Figure 6: Alcohol-Related Hospital Discharge Rates Per 100,000 Population 2001-2005



To understand the relationships among Maryland's alcohol need indicators and their relations to alcohol treatment admission rates, the study team examined the geographic distributions of the three alcohol need measures and the alcohol treatment rates. As noted in the descriptive section, Baltimore City had extremely high rates of alcohol mortality and hospital discharges, in each case about 50% higher than the next highest county. Outliers of that magnitude have a strong effect on correlations, especially when the number of cases is small. That factor partly explains why the Pearson correlation between the two alcohol measures was so strong while the Spearman rank-order correlation was weaker (.92 versus .83 respectfully in Table 3). Baltimore City also has extremely high drug mortality and drug hospital discharge rates, which probably also explains why the alcohol mortality and hospital discharge indicators correlate highly with their counterpart drug mortality and hospital discharge indicators. The large number of homeless persons in Baltimore may play an important role in explaining these mortality and hospital discharge rates. However, Baltimore City's rate on the remaining alcohol need measure (alcohol arrests) was the *lowest* in the state (364.8 per 100,000).

Figure 7: DUI/DWI Arrest Rates per 100,000 Population 2001-2005

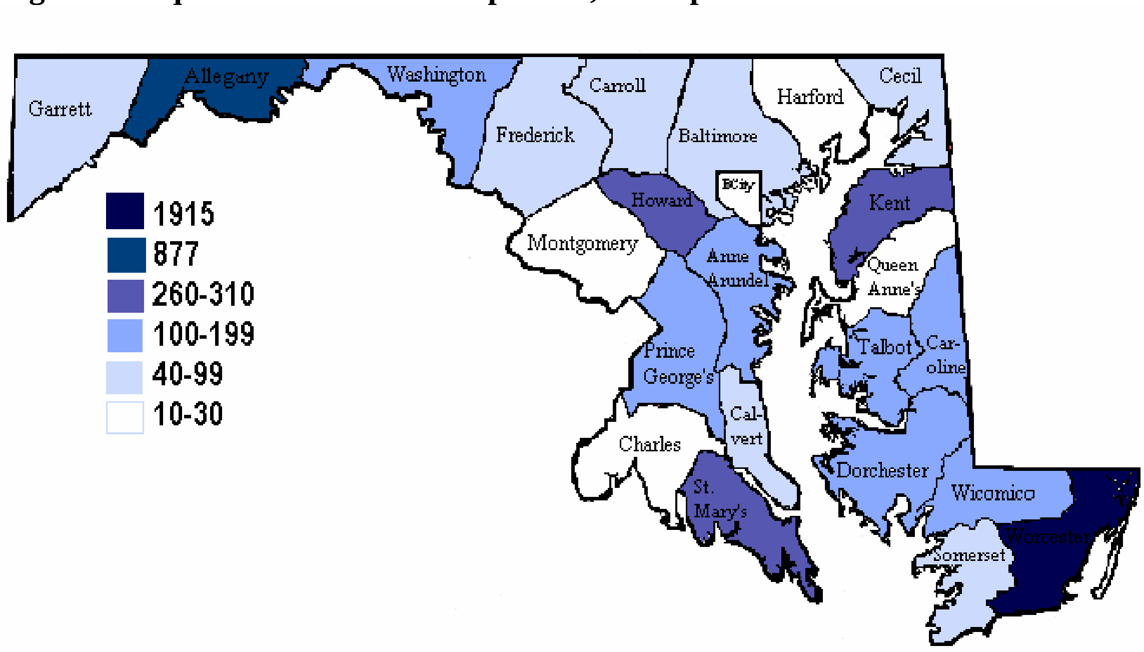


Baltimore City's DUI/DWI arrest rate was also the lowest in the state for that period (Figure 7), which is also true for inner city areas in other states such as Boston and Providence, Rhode Island. Baltimore City's liquor law violation rate was the fifth lowest in the state (Figure 8). The disorderly conduct arrest rates have a somewhat different geographic distribution pattern than the DUI/DWI and liquor law violations rates (Figure 9). In particular, Baltimore City has a relatively high rate of disorderly conduct arrests. A primary rationale for inclusion of disorderly conduct as an alcohol arrest variable was that it incorporates incidents of drunkenness episodes that are no longer illegal in many states. Public drunkenness tends to be an urban phenomenon. Disorderly conduct arrests correlated more strongly than the other two alcohol arrest rates with alcohol mortality and hospital discharges.

Of the alcohol need indicators used in this study, the DUI/DWI arrest rates have the strongest correlation with alcohol treatment admissions (.73), while the disorderly conduct arrests rates were second most strongly related to treatment admissions (.68). Although Baltimore City's disorderly conduct arrest rate was seventh highest in the state, the other two arrest measures dominated the composite alcohol arrest rate measure.

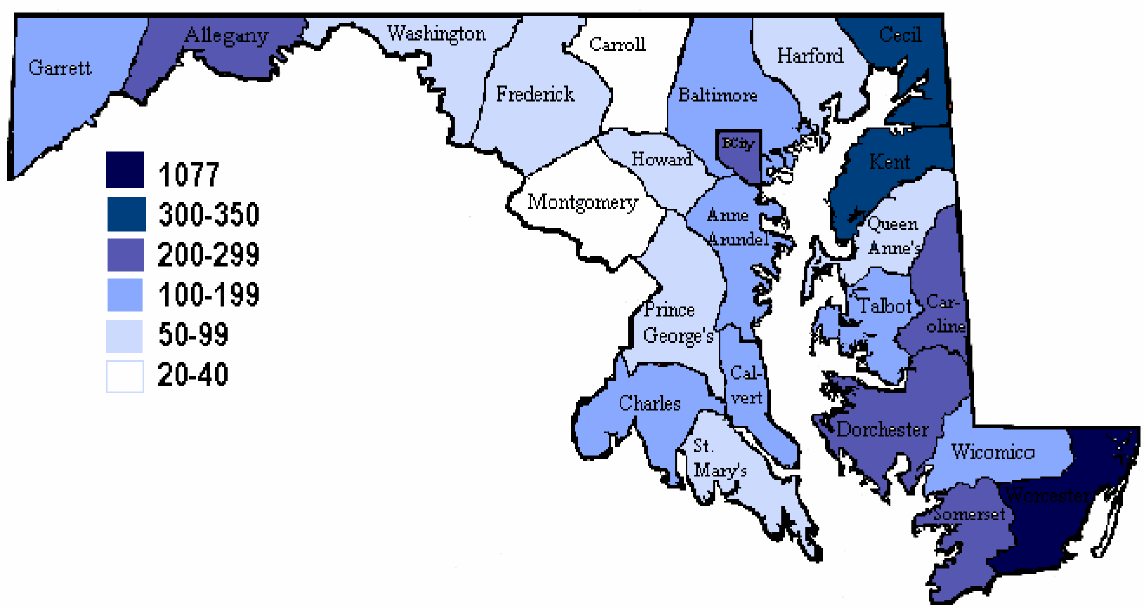
The different alcohol indicators (deaths and hospital discharges versus arrests) appear to reflect two distinct patterns of alcoholism. One pattern is associated with the alcohol related deaths and hospital discharges stemming most strongly from severe chronic alcoholism in Baltimore City. The other pattern is associated with driving under the influence and liquor law violations, most likely found in less severely ill populations in state- and federally-designated rural areas in Western Maryland, Southern Maryland and on the Eastern Shore (Maryland State Office of Rural Health 2007), and especially in Worcester County, whose alcohol arrest rates are about as extreme as Baltimore City's drug arrest rates. Liquor law violations often reflect underage drinking and adult drinking in resort areas. Thus, whereas the three drug indicators appear to measure an underlying drug problem that is one-dimensional, the alcohol indicators appear to measure an underlying alcohol problem that is two-dimensional: one among chronic alcoholics in urban areas especially Baltimore City and the other among youth and adults in suburban-rural and resort areas.

Figure 8: Liquor Law Arrest Rates per 100,000 Population 2001-2005



Because both alcohol dimensions can cause people to seek treatment, both should be used to assess treatment need. However, the lack of geographic association between them undermines the usual assumptions of the convergent and discriminant validation methodology. It assumes that empirical measures of the same concept (such as alcoholism) would correlate positively. That assumption appears to be sound in the case of Maryland's drug problems and indicators, but as just explained may not occur in the case of Maryland's and other states' alcohol problems and indicators. Consequently, we sought to validate the alcohol arrest indicator by comparing it with other alcohol indicators besides alcohol mortality and alcohol hospitalization rates. The results showed that the alcohol arrest rate in 2001-2005 correlated .83 with the rate of alcohol and drug impaired drivers in a crash during 2001-2006, and .44 with an alcohol or drug impaired driver in a fatal crash in the same years. Although the drunk-driving crash and fatality data derive in part from police records and highway incidents, they also stem from a range of other data sources (vital statistics, state highway department data, emergency medical service reports, hospital medical records, and driver licensing files). Consequently, the crash statistics provide just a modest amount of evidence corroborating the validity of the alcohol arrest statistics. Another source of corroboration, of course, is that the alcohol arrest rates correlated more strongly than any other alcohol indicator with alcohol treatment admissions. In Maryland, courts may require as a condition of probation that persons arrested repeatedly for driving under the influence (DUI) or driving while impaired (DWI) be evaluated to determine whether they are problem drinkers who need treatment or social drinkers who need an educational program. Treatment for repeat offenders is mandatory if recommended by the evaluation. Many of the treatment programs in the state include DUI/DWI programming on their list of services. This relationship between the drunk-driving laws and mandatory treatment is a clear contributor to the correlation between alcohol arrests and alcohol treatment admissions.

Figure 9: Disorderly Conduct Arrest Rates per 100,000 Population 2001-2005



To assess the impact of extreme values on the correlations between the drug and alcohol indicators, especially in Baltimore City, the study team calculated Spearman Rank-Order Correlations for the same measures (above and to the right of the diagonal in Table 3). Spearman correlations are Pearson correlations using data that have been converted to ranks. Comparison of the two types of correlations can reveal the influence of outliers or cases with extremely high or low values (Baltimore City) compared to the rest of the counties. The differences between the Pearson and Spearman correlations had a more noticeable effect on the correlations among the drug indicators than among the alcohol indicators (comparison of the counterpart correlations above and below the diagonal in Table 3). For example, the Pearson and Spearman correlations between drug mortality and drug admissions were .85 versus .33 respectively, while the Pearson and Spearman correlations between alcohol mortality and alcohol admission rates were .30 and .43 respectively. In the latter case, reduction of the influence of Baltimore City's extremely high alcohol mortality increased the correlation between the two measures. Similar differences occurred for alcohol hospital discharges and alcohol treatment admissions (.16 vs. .42). It is important to note that Baltimore City's extremely high values of alcohol mortality and hospital discharges probably reflect real differences between the city and other counties, and the differences between the types of correlations should not be interpreted as indications of the presence of measurement error. Instead, they should be viewed as indications of the importance of Baltimore City in determining the strong relationship between substance abuse need and services in Maryland. The Spearman correlations among the alcohol need indicators were slightly higher than the Pearson correlations in four instances. The differences between the Pearson and Spearman correlations were more pronounced in Maryland than they were in Massachusetts (McAuliffe 2005)—most likely reflecting the unique position of Baltimore City.

Table 3. Multi-trait, Multi-method Correlation Matrix of Maryland's Drug and Alcohol Need Indicators and Treatment Rates: Pearson and Spearman Correlations; Factor Analysis

	Drug				Alcohol			
Measure (Rate/100,000)	Mortality	Hospital Discharges	Arrests	Admissions	Mortality	Hospital Discharges	Arrests	Admissions
Drug Mortality	. . .	**0.45***	**0.15**	0.33	0.32	*0.32*	*-0.32*	*-0.16*
Drug Hospital Discharges	**0.93***	. . .	**0.41***	0.71*	*0.63**	0.90*	*0.10*	*0.18*
Drug-Defined Arrests	**0.86***	**0.83***	. . .	0.72*	*0.76**	*0.61**	0.61*	*0.63**
Drug Treatment Admissions	0.85*	0.93*	0.88*	. . .	*0.71**	*0.82**	*0.33*	0.64*
Alcohol Mortality	0.77*	*0.83**	*0.88**	*0.86**	. . .	**0.83***	**0.43***	0.43*
Alcohol Hospital Discharges	*0.80**	0.93*	*0.78**	*0.91**	**0.92***	. . .	**0.34**	0.42*
Alcohol-Defined Arrests	*-0.07*	*-0.16*	0.30	*0.01*	**0.30**	**0.01**	. . .	0.71*
Alcohol Treatment Admissions	*-0.08*	*-.05*	*0.25*	0.27	0.30	0.16	0.67*	. . .
Orthogonal Factor Analysis Weights								
Drug	**0.93**	**0.98**	**0.91**	**0.96**	**0.91**	**0.95**	0.00	0.09
Alcohol	-0.14	-0.17	0.26	0.10	0.30	0.05	**0.92**	**0.90**

Note: The cells below the diagonal (lower left) are Pearson product-moment correlations, while the cells above are Spearman-Brown rank-order correlations. Bolded correlations are convergent validities, while the bolded factor weights define the dimensions. Underlined figures are "method effects." Italicized correlations are between measures that have neither substance nor methods in common.

There was suggestive evidence of so-called "method effects," a form of systematic error, in the mortality and hospital discharge measures. The relevant correlations in Table 3 are underlined. The correlation between drug and alcohol mortality rates was .77, and the correlation between drug and alcohol hospital discharges was .93. By contrast, method effects were less apparent in the .30 correlation between drug and alcohol arrests and the .27 correlation between the drug and alcohol admission rates. The correlation between the drug and alcohol discharge measures was equal to or higher than any correlations between those two measures and any other indicators. These correlations apparently reflect Baltimore City's high rates and the effect of the similarity of the coding systems (the ICD-9-CM diagnostic coding rules).

There is of course broad consensus that alcohol and drug use disorders overlap substantially at the individual level. In part, the high degree of overlap observed for county mortality and hospital discharge rates and relative lack of overlap for the drug and alcohol arrest and treatment admission rates may reflect differences in the different measures' rules for coding persons who have both drug and alcohol problems. In both mortality and hospital discharge data a case with both a drug and alcohol diagnostic code is counted in both the drug and the alcohol mortality and hospital discharge rates. In the treatment admission and arrest data, the cases with both problems are counted by the primary drug or the most serious offense only. Therefore, all admissions and arrest cases with both alcohol and drug problems are counted as either primary drug or alcohol, but not both. The positive correlations between the drug and alcohol admissions as well as the drug and alcohol arrests may reflect the overlap between the concepts of drug and alcohol problems. The existence of method effects is a primary reason for creating a composite index of indicators based on multiple data collection systems rather than one data system such as mortality (as in the National Institute on Alcohol Abuse and Alcoholism's [NIAAA] County Problem Indicators) (Stinson et al. 1994). In the composite index the method variance from any one data system is "averaged out" when combined with measures that contain method variance from other data systems.

Another set of correlations in Table 3 is among measures that have neither the concept (drugs or alcohol) nor the measurement system in common. For example, there is a -.16 correlation between drug mortality rates and alcohol treatment admission rates. This correlation reflects the amount of overlap between the concepts being measured (drug or alcohol problems in counties) and overlap between the alcohol and drug concepts and the two respective data collection systems (arrests and hospital discharges). The expectation of the validation methodology is that these correlations would be the lowest in the matrix, ideally no greater than chance. Moreover, the bolded correlation (.93) between the mortality and hospital discharge measures for the same substance (drugs) should exceed the counterpart set of italicized correlations between mortality and hospital discharge measures for different substances (.80 between drug mortality and alcohol hospital discharges, or the .83 correlation between alcohol mortality and drug hospital discharges). Similarly, the convergent validity correlation between drug arrests and drug hospital discharges (.83) exceeds the correlations between drug arrests and alcohol hospital discharges (.78) and also between alcohol arrests and drug hospital discharges (-.16). A contrary instance is that the .86 convergent validity correlation between drug arrests and drug mortality is slightly lower than the correlation between drug arrests and alcohol mortality (.88), but the .86 correlation is higher than the -.07 correlation between alcohol arrests and drug mortality. The expected pattern also holds true for alcohol mortality and alcohol hospital discharges (.92), which exceeds the .83 correlation between alcohol mortality and drug hospital discharges and the .80 correlation between alcohol hospital discharges and drug mortality. The pattern breaks down for the correlations between alcohol arrests and the other two alcohol need indicators: the correlation between alcohol mortality and alcohol arrests is lower than between drug arrests and alcohol mortality (.30 versus .88), and the correlation between alcohol arrests and alcohol hospital discharges is lower than the correlation between than the correlation between drug arrests and alcohol hospital discharges (.01 versus .78). The anomalies appear to be driven by the outlier values in Baltimore City.

The factor analysis at the bottom of Table 3 is meant to reduce these many relationships into independent (uncorrelated or "orthogonal") alcohol and drug dimensions. The two-factor analysis of these indicators suggests the expected drug and alcohol dimensions, but also reveals the split in the alcohol measures consistent with our analysis of the correlations among the alcohol need indicators. The first factor had positive weights above .90 for all of the variables except alcohol arrests and alcohol admissions. We have interpreted the factor as an underlying drug dimension. However, the high loading of the alcohol mortality and hospital discharge rates on the drug rather than the alcohol factor raised questions about those two variables. The second factor was interpreted as reflecting an underlying rural alcohol dimension, with its substantial weights being on the alcohol arrests (.92) and the alcohol treatment admission rate (.90). The weight for alcohol mortality (.30) on the alcohol dimension is much smaller than alcohol arrests and admissions, but positive. The alcohol hospital discharge weight on the alcohol dimension was effectively zero (.05). The drug indicators had small positive or negative weights on the alcohol factor, with half being positive and half negative (Table 3). The pattern of loadings on the two dimensions resembled the results McAuliffe (2005) found in Massachusetts, although the size of the positive weights was slightly higher in Maryland.

Indicator and Index Construction

The drug, alcohol, and substance abuse need indexes were constructed from standardized versions of the drug and alcohol mortality, hospital discharge, and arrest rates. The mortality and hospital discharge data included cases with drug-only diagnoses, alcohol-only diagnoses, and both alcohol and drug diagnoses. The arrest data are coded only as drug or alcohol arrests. The *primary* drug and alcohol treatment cases were similarly either drug or alcohol only. For the Drug Need Index, we combined the cases diagnosed as drug-only and drug-and-alcohol mortality to create the drug mortality indicator. The drug hospital discharge indicator was similarly constructed. The drug arrest variable included only drug arrests. The Alcohol Need Index's components were similarly constructed, combining alcohol-only and alcohol-and-drug mortality and hospital discharges. The alcohol arrest variable included just the alcohol arrest cases. The Substance Abuse Need Index combined alcohol-only, drug-only, and drug-and-alcohol deaths to produce the substance abuse mortality component. The hospital discharge component was created similarly. The substance abuse arrest indicator combined both drug and alcohol arrests. Each of these indicators were converted to standard scores (z-scores), added up, and scaled to range theoretically from 0 to 100. This process is illustrated in Table 11 in Appendix E.

The effective weights of the components of the Drug Need Index were virtually equal: .34 for drug mortality rates, .33 for drug arrest rates, and .33 for drug hospital discharge rates. Although the evidence confirming the validity of the alcohol need indicators was considerably less than the evidence for the drug need indicators, the three alcohol indicators were included in the ANI. Because of its weak correlation with the other two alcohol indicators, the effective weight of the alcohol arrest indicator was lower (.24) than the weights of the alcohol mortality rates (.41) and the alcohol hospital discharge rates (.35). In the SNI, effective weights were .36 for substance abuse hospital discharges, .34 for substance abuse mortality, and .30 for substance abuse arrests. The slightly lower weight of the arrest variable continued to reflect the lack of convergence between the alcohol arrest variable and the other two alcohol indicators.

Index Reliability and Stability

The DNI and SNI had substantial internal-consistency and test-retest reliability, while the ANI was not quite as reliable. The internal-consistency measure of reliability of the need indexes was Cronbach's (1951) alpha for standardized items. The alpha reliabilities of the DNI, ANI, and SNI were .95, .68, and .88 respectively. To measure the test-retest reliability of the need indexes, we also constructed a Maryland Drug Need Index of standard scores of drug deaths and drug arrests for 1994-2000 (hospital discharges were not available), and a parallel index for alcohol arrests and deaths in 1994-2000. The DNI for 1994-2000 correlated .98 with Maryland's DNI for 2001-2005, which included deaths, arrests, and hospital discharges. The Maryland ANI for 1994-2000 correlated .82 with the ANI for 2001-2005. The Maryland SNI for 1994-2000 based on just deaths and arrests correlated .92 with the 2001-2005 SNI based on deaths, arrests, and hospital discharges. These results for measures of internal-consistency and test-retest reliability were consistent with each other and indicate a satisfactory level of reliability of the composite indexes.

The great stability of the state's drug and alcohol problems as measured by the test-retest correlations is an important substantive finding for administration and policy-making concerning substance abuse services in Maryland. The relative differences among the counties as measured by these indicators of serious drug and alcohol problems have changed little in the past ten years. While drug and alcohol problems may increase or decrease statewide, the relationships among the countries remains relatively unchanged. This finding means that the treatment system can remain relatively stable without the need for rapid adjustments in its geographic structure to keep up with the state's substance abuse problems. Filling treatment gaps over a period of time therefore makes sense. It also has methodological implications for this study's use of 2001-2005 data to estimate treatment needs in 2008. A lag of a few years from the period covered by the latest need and admission data until the present is unlikely to cause significant error.

Construct Validity

Substantial evidence of the construct validity of the drug and alcohol need indexes may be inferred from the pattern of correlations in Table 4. Each of the table's variables has a theoretical connection with drug or alcohol abuse. If the DNI and ANI have construct validity, their respective correlations with the validators should be consistent with theoretical expectations; specifically, the DNI will correlate more strongly than the ANI with variables related to drug abuse. The reverse is true for variables related to alcohol abuse. The correlations in bold font were consistent with theoretical expectations. The DNI and ANI were correlated moderately strongly with each other (.76), but there was also evidence that the two were somewhat distinct.

The first set of correlations confirmed the expected pattern of relations between the need indexes and the respective treatment admission rates. The DNI correlated strongly (.93) with the total drug treatment admission rates. This finding confirms results from previous indicator studies in Massachusetts between 1997 and 2001 (correlation of .90) and in Rhode Island during 1993-1998 (correlation of .85) (McAuliffe et al. 2002a; McAuliffe 2005). As expected, the DNI did not correlate as strongly with alcohol treatment admissions (.04). The DNI correlated more highly than the ANI (.91 versus .55) with the rate of discharges from a hospital following inpatient drug treatment. The results for hospital drug treatment were similar to those in Massachusetts and Rhode Island but somewhat stronger (McAuliffe et al. 2002a; McAuliffe 2005). However, there was no difference between the DNI and ANI regarding their respective correlations with hospital alcohol discharges rates. Another anomaly for the ANI is that its correlation with drug treatment admissions is higher than its correlation with alcohol treatment admissions. This result again reflects the importance of Baltimore City in the alcohol mortality and hospital discharge indicators.

The relationships between the need indexes and county demographic rates were consistent with expectations in two out of three instances. The percentage of the population that was non-white correlated more highly with the DNI than the ANI, a result identical to findings in the needs assessment studies of Massachusetts and Rhode Island. The DNI correlated more highly than the ANI with the rate of homeless in shelters (a stronger difference than in Rhode Island), but there was little difference between the correlations of the two need indexes with poverty in Maryland. The latter result contrasted with the results from Massachusetts and Rhode Island (McAuliffe 2005; McAuliffe et al. 2002), where poverty rates were more highly correlated with rates of drug problems than rates of alcohol problems.

The comparisons of the DNI and ANI with survey estimates from the BRFSS and the NSDUH were mostly inconsistent with theoretical expectations, but the cause appeared to be shortcomings of the survey validators rather than the need indexes. The BRFSS heavy drinking estimate (% of respondents who averaged two drinks or more per day in the past month; previously called “chronic” drinking) correlated more strongly with the ANI than the DNI (.51 versus .13), but the BRFSS binge drinking variable was uncorrelated with both indexes (-.02 with the DNI and .04 with the ANI). It is noteworthy that neither of the two BRFSS alcohol measures correlated significantly with the NSDUH alcohol use disorder measures, and the BRFSS binge drinking variable (five or more drinks once in the past month) did not correlate significantly with any of the other alcohol-related validators obtained by the study (alcohol related crashes, alcohol hospital discharges, and liquor license rate). It is likely that the “binge drinking” measure does not tap the level of severity measured by the ANI.

The correlations between the NSDUH use disorder estimates and the need indexes were not much better. Because the NSDUH regional estimates were produced for only four individual counties, the multi-county regional estimates had to be generalized to each individual county in order to use the NSDUH estimates as a validator. The estimated NSDUH drug use disorder rates for 2005-2006 correlated more highly with the DNI than with the ANI (.72 versus .30), but the 2002-2004 drug use disorder estimates did not (.32 versus .50). Neither the 2002-2004 nor the 2005-2006 NSDUH alcohol use disorder measures correlated more strongly with the ANI than with the DNI. In interstate analyses, McAuliffe and Dunn (2004) found that the NSDUH use disorder measures lacked substantial evidence of discriminant validity.

The DNI correlated more highly than the ANI with the IDU-AIDS rate and with the syphilis rate, a contagious disease long known to be associated with drug use. The result for IDU-AIDS replicates similar results in Rhode Island and Massachusetts (McAuliffe 2005; McAuliffe et al. 2002a). The DNI also had a higher correlation than the ANI with the robbery and prostitution arrest rates, but the reverse was true for the breaking and entering arrest rates. As expected the ANI correlated more strongly than the DNI with the liquor license rate per 100,000, the per capita alcohol consumption rate, and with rates of alcohol- and drug-impaired-driver crashes and fatal crashes.

Table 4. Construct Validity of DNI and ANI: Correlations

Rates Per 100,000, 2001-2005	DNI	ANI
Alcohol Need Index (ANI)	.76*	. . .
Drug Treatment Admissions, Publicly and Privately Funded	**.93****	76*
Alcohol Treatment Admissions, Publicly and Privately Funded	.04	**.48***
Hospital Drug Treatment Discharges	**.91***	.55*
Hospital Alcohol Treatment Discharges	.48	.48
% Below Poverty Level, 2004	.59*	.60*
% Nonwhite, 2000	**.48***	.17
% People in Non-institutional Group Homes (shelters), 2000	**.35**	.06
% Heavy Drinking, 18 and older, BRFSS 2001-2005	.13	**.51***
% Binge Drinking, 18 and older, BRFSS 2001-2005	-.02	.04
% Binge Drinking, 12th graders, 2000-2005	-.53*	-.19
% Drug use disorder, NSDUH 2002-2004	.32	.50*
% Drug use disorder, NSDUH 2005-2006	**.72***	.30
% Alcohol use disorder, NSDUH 2002-2004	.80*	.64*
% Alcohol use disorder, NSDUH 2005-2006	.34	.03
IDU-HIV/AIDS Prevalence Rate, 2001-2005	**.96***	.58
Syphilis Rate, 2004	**.83***	.42*
Alcohol and drug impaired driver in fatal crash rate, 2001-2005	-.14	**.31**
Alcohol and drug impaired driver in crash rate, 2001-2005	.09	**.51***
Breaking and Entry Arrest Rate, 2001-2005	.54*	.78*
Prostitution Arrest Rate, 2001-2005	**.94***	.54*
Robbery Arrest Rate, 2001-2005	**.81***	.55*
Liquor license rate, 2001-2005	.22	**.72***
Per Capita Consumption of Spirits, Beer, and Wine, 2001-2005	.20	**.66***

Thus, except for the survey estimates, a majority of the correlations in Table 4 were consistent with theoretical expectations and previous findings in Rhode Island and Massachusetts, thereby providing empirical support for the construct validity of Maryland's drug and alcohol need indexes. A factor analysis of the drug and alcohol validator variables and the indexes showed that they formed two distinct factors. There were, however, a number of exceptions, especially among the survey measures. In some cases, validators such as BRFSS and NSDUH estimates appeared to lack factorial validity, and that probably accounted for their failure to confirm theoretical expectations regarding their relations with the ANI.

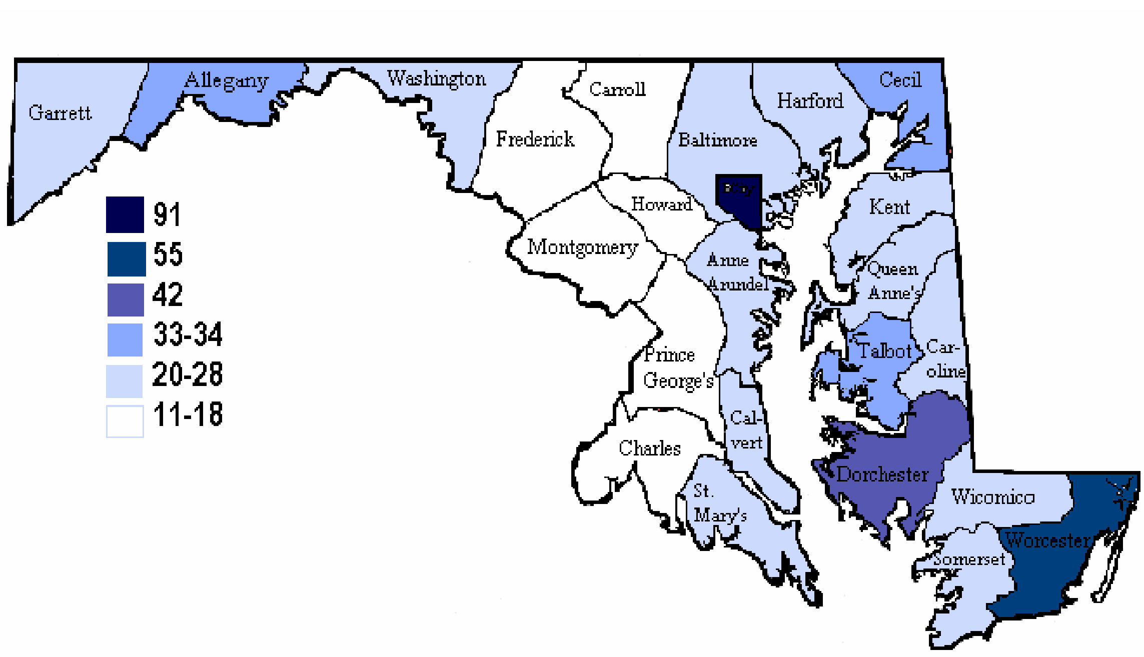
To illustrate the meaning of these correlations, we examined the MDDNI and MDANI scores for Baltimore City, Prince George's, Montgomery, and Cecil Counties (see Appendix E). Examination of Tables 9 and 10 in Appendix E revealed that the three need indicators were highly consistent with each other for Baltimore City, Cecil County, and Montgomery County, but not for drug mortality in Prince George's County. Similarly, the alcohol need indicators were generally consistent with each other except for alcohol arrests, especially in Baltimore City. Baltimore City's alcohol mortality and hospital discharge rates were the highest in the state, and its disorderly conduct arrest rate ranked 7th highest. However, the City's DUI/DWI and liquor law violation arrest rates were among the lowest in the state, ranking 24th and 20th respectively. Liquor law violations in Prince George's county ranked higher (9th) than any of its other alcohol need indicators. Our study of counties nationwide found that liquor law violation rates which include underage drinking tend to be relatively high in counties with large college campuses.

Comparison of the non-Index explicit-mention drug indicators showed that they were consistent with the Drug Need Index's components, again except for Prince George's County (its IDU AIDS rate was second highest in the state, while the county's other explicit-mention indicators ranked 11th and 22nd). The non-Index explicit-mention alcohol indicators were similarly mostly consistent with the MDANI components, with a few exceptions. For example, the Hospital alcohol treatment rate in Baltimore City was the highest in Maryland, while the fatal alcohol impaired driver crash rate was ranked 23rd in the state. Cecil County's non-Index explicit-mention alcohol indicators ranked slightly lower and were more varied than were its MDANI components. Montgomery County's alcohol treatment admission rate ranked 22nd but its hospital alcohol treatment rate ranked 8th. All of Prince George's County's non-Index alcohol indicators ranked among the lowest in the state, thus confirming the county's relatively low alcohol need index score.

Of particular note, the hospital discharge rates in Montgomery and Prince George's Counties were not ranked substantially lower than were their mortality or arrest rates (also see Table 12 in Appendix E). There was no clear evidence in these data that residents of Montgomery or Prince George's County were disproportionately going elsewhere to obtain hospital treatment for drug or alcohol related medical conditions. Montgomery County's rate of hospital discharges following alcohol treatment ranked eighth highest in the state, which was much higher than any other of the county's alcohol indicators in Table 10. If anything, it was the drug arrest rates of the two counties that were lower than expected compared to the rates of arrest for robbery and prostitution. A few counties (Worcester County on the Lower Eastern Shore and the Western Maryland counties of Allegany, Washington, and Garrett) had lower Z-scores for hospital discharges than Z-scores for the substance abuse mortality and arrest indicators.

Worcester County had an especially high rate of substance abuse arrests per 100,000 residents, even higher than Baltimore's. Many of the arrestees were probably not residents of the county, but visitors to Ocean City and other vacation destinations. Our discussions with state officials indicated that the visitors and summer employees also consumed substance abuse treatment and related services in the county. For example, detoxifications, treatment of overdoses, and brief counseling might be needed by non-residents. It was also noteworthy that the county's residents had the 3rd highest substance abuse mortality rate in the state. At the state's direction, we did not remove the substance abuse arrests that occurred in the summer months.

Figure 10: County Substance Need Index Scores

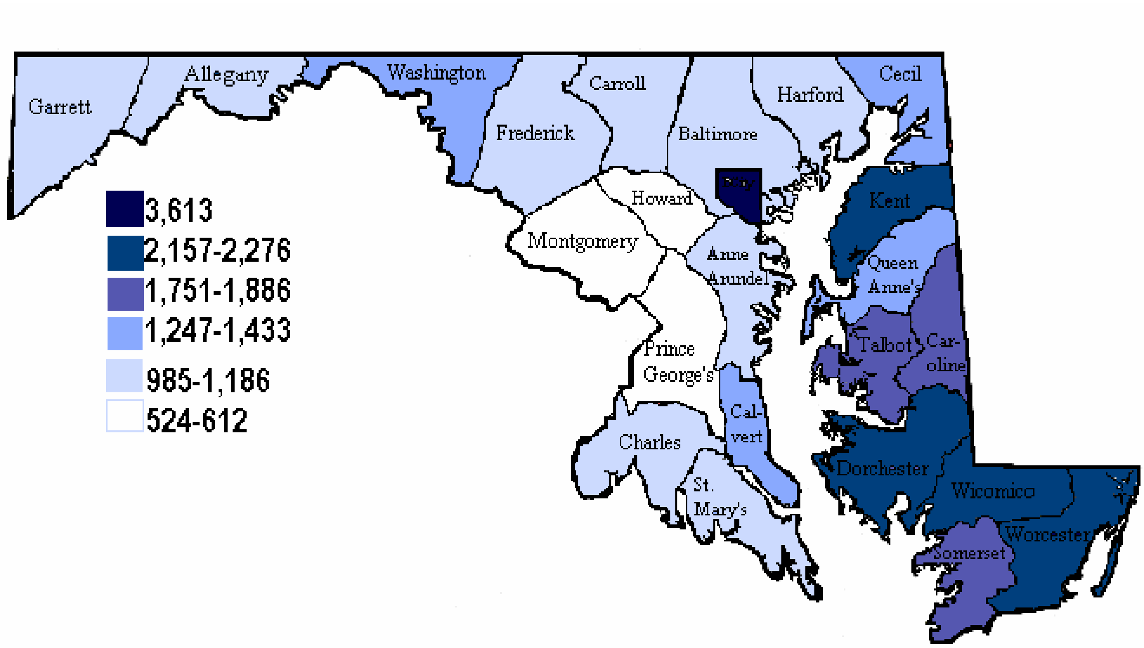


Distribution of Treatment Need and Services

As expected, Baltimore City had the highest level of the substance abuse treatment need in the state (SNI = 91) (Table 5 and Figure 10). Its DNI was 100 (Baltimore City's drug mortality, hospital discharge, and arrest rates were all the highest in the state during 2001-2005), and its ANI was equal to 69 (also the highest ANI in the state, but each component was not the highest)

(Figures 4, 5, and 6). The next highest SNI scores were in counties on the Eastern Shore: Worcester (55), Dorchester (42), Talbot (34), and Cecil (33). In Western Maryland, Allegany County had the highest SNI score (33). The state's lowest SNI scores were in a belt of mostly affluent suburban and rural counties that runs up the center of the state from the Washington, DC area and west of Baltimore County. Montgomery County had the lowest SNI score (11), followed by Howard County (14), Prince George's County (15), Charles County (16), Fredrick County (18), and Carroll County (18). Overall, the mean SNI score for the 24 counties was 27.2, and the median was 21.7. The difference between the mean and median reflected the influence of the skew in the distribution caused by Baltimore City's exceptionally high SNI score.

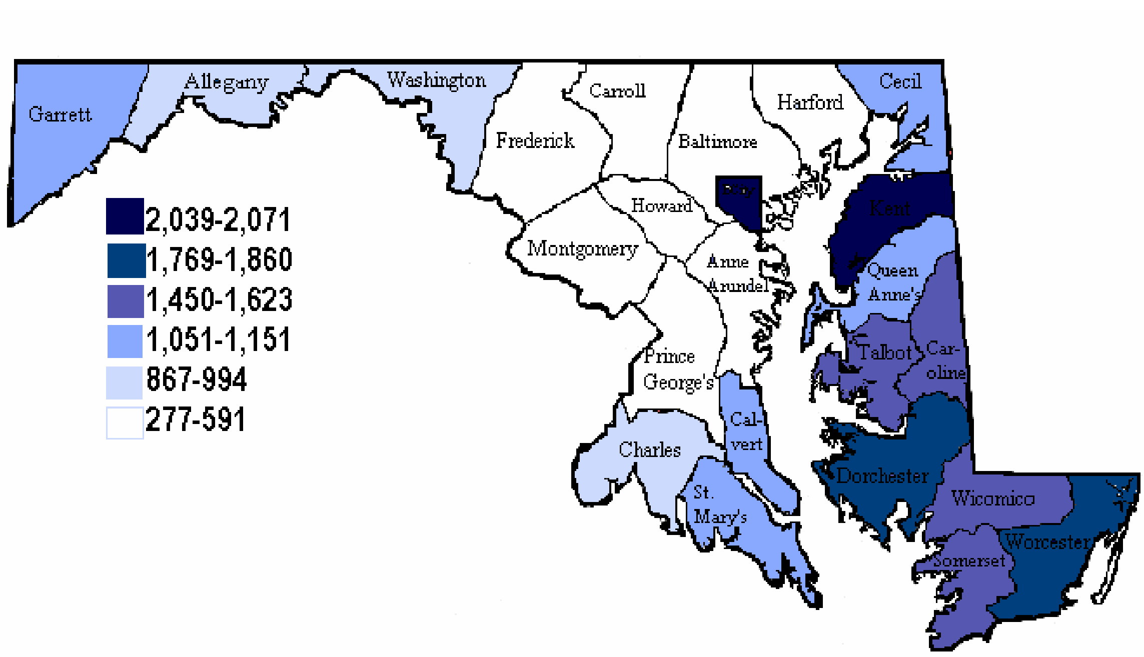
Figure 11: Total County Substance Abuse Treatment Admission Rates



Like the SNI scores, the substance abuse treatment admission rates from privately- and publicly-funded treatment programs were highest in Baltimore City and on the Eastern Shore, especially the lower Eastern Shore (Figure 11). After Baltimore City (3,613 per 100,000), the highest total substance abuse treatment admission rates per 100,000 residents were in Worcester (2,276), Kent (2,267), Wicomico (2,184), and Dorchester counties (2,158). Somerset (1,885 per 100,000), Talbot (1,857), and Caroline (1,751) counties had the next highest substance abuse treatment rates. The total substance abuse treatment admission rates in the remaining counties were substantially lower, with the cluster of Prince George's, Montgomery, and Howard counties having by far the three lowest rates.

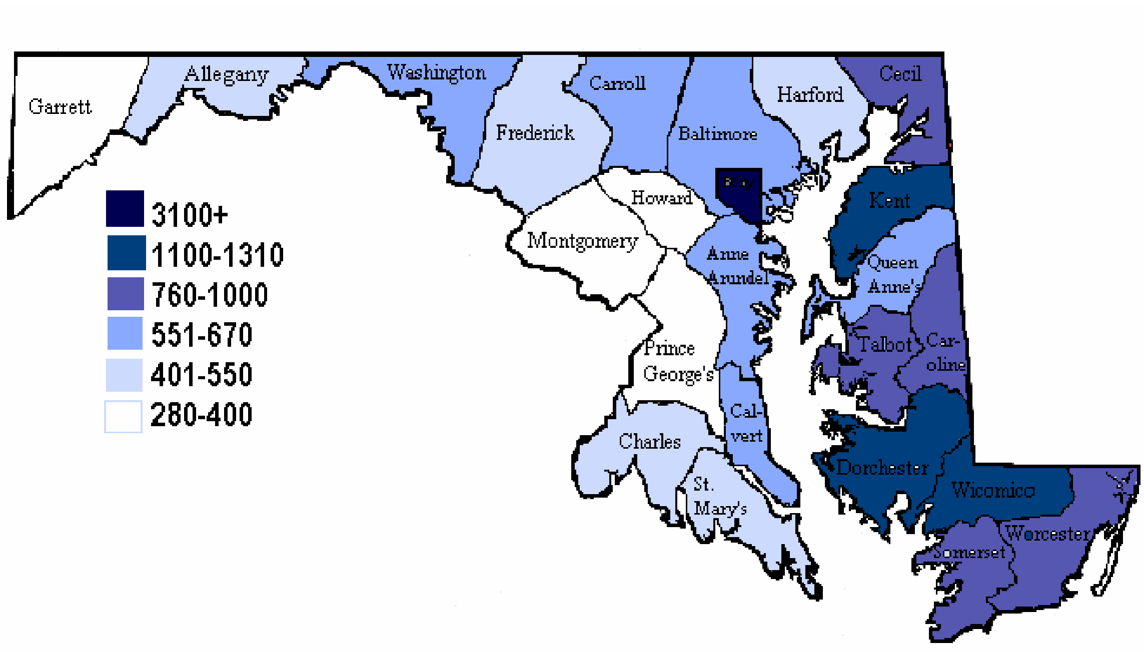
When only substance abuse treatment admissions to programs that received some public funding were considered (Figure 12), the highest rates were Baltimore City (2,071 admissions per 100,000) and Kent County (2,040). The lowest rates were in a large cluster of suburban and rural counties surrounding Baltimore City and Washington, DC. The lowest substance abuse treatment admissions rates in publicly-funded programs were in Howard (277 per 100,000), Prince George's (281), Montgomery (335), Harford (417), Baltimore (468), Anne Arundel (525) and Carroll (591) counties.

Figure 12: Public County Substance Abuse Treatment Admission Rates



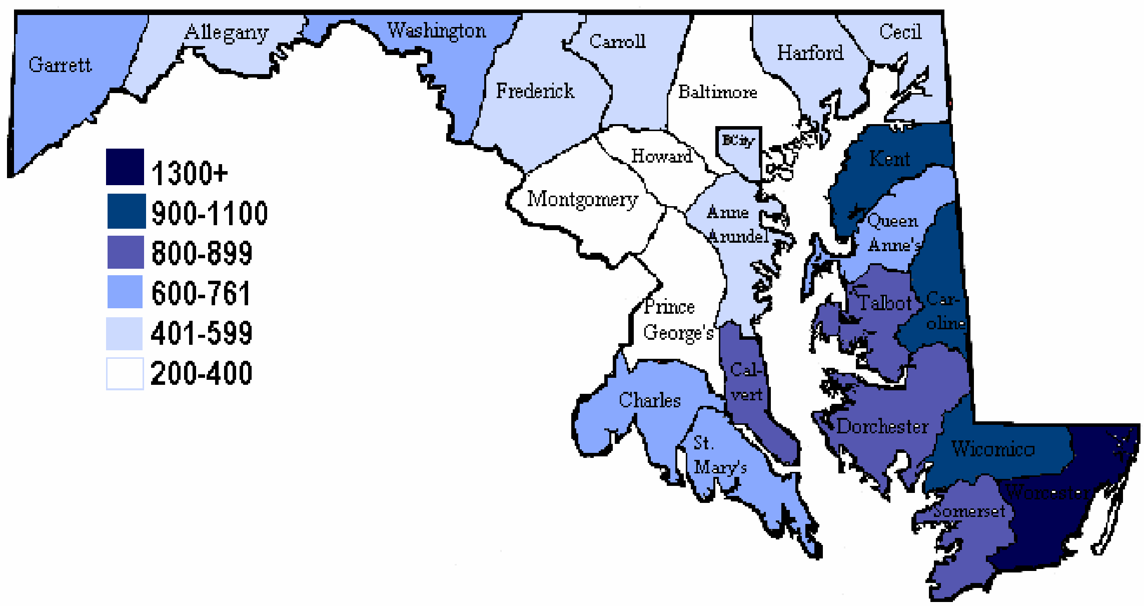
It is noteworthy that these counties, along with Fredrick County, had the lowest *percentage* of the total substance abuse treatment admissions in programs that received funds from ADAA. The range of proportions of county admissions that were to publicly-funded programs was substantial: 42% to 95%. Five of the counties had fewer admissions to publicly-funded than privately-funded programs: Harford (42%), Anne Arundel (46%), Baltimore (46%), Howard (49%), and Fredrick (49%) counties. The counties with the next lowest percentage of publicly-funded treatment admissions during the study period were Prince George's (54%), Montgomery (55%), and Carroll (56%). Although Baltimore City had more admissions to publicly-funded than privately-funded programs (57%), its per capita rate of privately-funded substance abuse treatment admissions exceeded the private treatment rates of other counties to a greater extent than its publicly-funded admission rate exceeded the publicly-funded rates of other counties. Besides ADAA, the sources of funding for Baltimore City's treatment providers have included health insurance, federal grants, and foundation grants (Drug Strategies 2000). Counties with the five highest percentages of publicly-funded treatment admissions were Garrett (95%), Allegany (90%), Kent (90%), Saint Mary's (89%), and Somerset (86%). The median percentage was 77%, while the mean was 70%.

Figure 13: Total Drug Treatment Admission Rates per 100,000 Population 2001-2005



Treatment admission rates for both primary alcohol and primary drugs were high on the Lower Eastern Shore, while Prince George's, Montgomery and Howard counties had the lowest rates for both primary substance categories (Figures 13 and 14). Slightly more Maryland counties had a greater number of primary drug than primary alcohol admissions (Table 5). In the country as a whole, most counties had more primary alcohol than primary drug admissions.

Figure 14: Total Alcohol Treatment Admission Rates per 100,000 Population 2001-2005



Comparing the SNI scores with county substance abuse treatment admission rates in Table 5 revealed the details of the positive correlation between them (Pearson .85; Spearman .79). Baltimore City's SNI and total substance abuse treatment admission rate were the highest in the state. Montgomery County's SNI score was the lowest, and its substance abuse treatment admission rate was third lowest. Both of Howard County's need and treatment rates were second lowest in the state. However, the relationship between need and treatment admission rates was not perfect. Baltimore County's treatment admission rate, especially its publicly-funded services (ranked only 20th out of 24), was clearly lower than one might expect on the basis of its SNI score (ranked 8th in the state). Similarly, Allegany County's SNI ranked 6th in the state, but its total admission rate ranked 16th.

Table 5. Treatment Need Indexes and Rates of Treatment Admissions, 2001-2005

Counties	Substance Need Index (SNI) Scores	Substance Treatment Admission Rates Per 100,000			Drug Need Index (DNI) Scores	Primary Drug Treatment Admission Rates	Alcohol Need Index (ANI) Scores	Primary Alcohol Treatment Admission Rates
		Total	Public	Private				
1. Baltimore City	91	3,613	2,071	1,542	100	3,104	69	509
2. Worcester	55	2,276	1,860	416	30	925	65	1,351
3. Dorchester	42	2,158	1,769	388	27	1,306	51	851
4. Talbot	34	1857	1451	407	16	972	42	885
5. Cecil	33	1408	1,060	349	20	836	39	572
6. Allegany	33	1,102	994	108	12	542	44	560
7. Kent	28	2,267	2,040	227	13	1,191	34	1,076
8. Baltimore County	27	1,012	468	544	21	632	29	381
9. Wicomico	26	2,184	1,551	633	20	1,149	28	1,035
10. Caroline	24	1,751	1,497	255	13	796	31	956
11. Calvert	23	1,432	1,142	290	13	611	27	821
12. Washington	22	1,248	868	380	13	604	26	644
13. Anne Arundel	21	1,147	525	622	14	670	25	477
14. Somerset	21	1,885	1,623	263	8	989	28	896
15. Harford	21	985	417	569	13	502	24	483
16. Queen Anne’s	21	1,391	1,151	241	12	661	24	730
17. Saint Mary’s	20	1,186	1,051	135	11	508	26	678
18. Garrett	20	1,139	1,084	55	7	379	25	760
19. Carroll	18	1,053	591	463	12	590	20	463
20. Fredrick	18	1,008	497	511	11	476	21	532
21. Charles	16	1,094	887	207	9	493	20	601
22. Pr. George’s	15	524	281	243	9	306	18	218

Table 5. Treatment Need Indexes and Rates of Treatment Admissions, 2001-2005

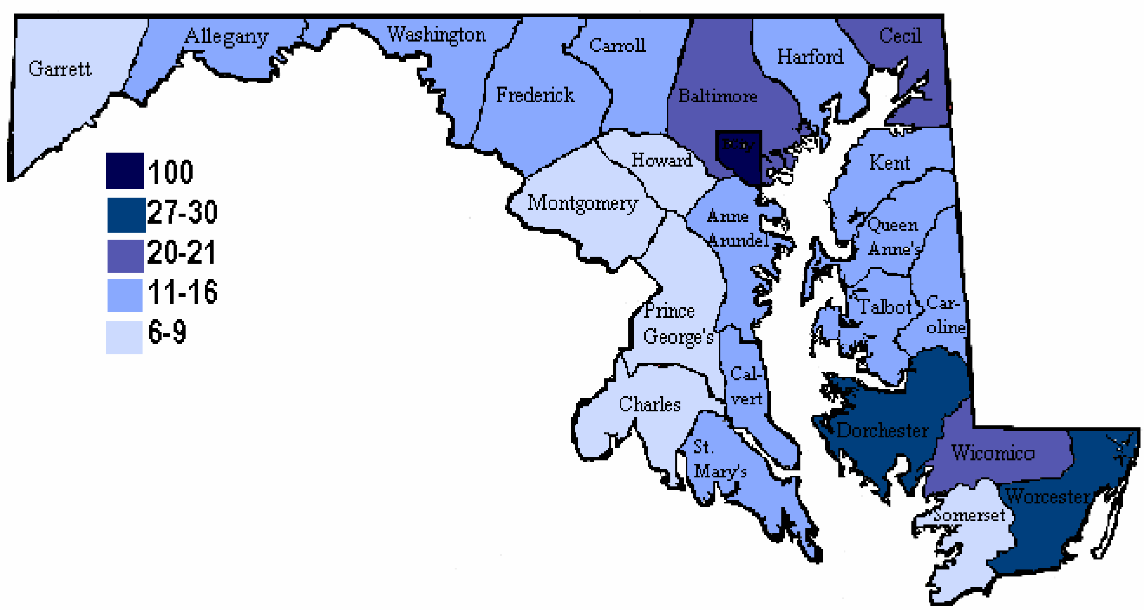
Counties	Sub-stance Need Index (SNI) Scores	Substance Treatment Admission Rates Per 100,000			Drug Need Index (DNI) Scores	Primary Drug Treatment Admission Rates	Alcohol Need Index (ANI) Scores	Primary Alcohol Treatment Admission Rates
		Total	Public	Private				
23. Howard	14	571	277	294	8	300	16	272
24. Montgomery	11	612	335	276	6	285	13	327

Baltimore City (DNI= 100) as well as the Lower Eastern Shore counties of Worcester (30, 2nd highest in the state) and Dorchester (27) had the highest need for drug treatment services, while Montgomery (DNI= 6), Garrett (7), Somerset (8), Howard (8), Charles (9), and Prince George's (9) counties had the lowest levels of drug treatment need. The mean county DNI score was 17.4, and the median was 12.7. The difference between these two measures of central tendency again reflects Baltimore City's exceptionally high level of per capita need for drug treatment services compared to the other counties. Most of the western counties had relatively low levels of drug treatment need: only Washington County (13) was above the median. The correlations between the DNI and drug treatment admissions were .93 (Pearson) and .72 (Spearman Rank Order).

A seeming drawback of the Maryland DNI is the shape of the distribution of its scores. While Baltimore City has a score of 100, all of the other counties have DNI scores between 6 and 30. However, we concluded that the distribution appropriately reflected the extreme nature of the drug treatment needs of Baltimore City's residents compared to the moderately low level of drug treatment needs in nearly all of the state's other county populations. In an unpublished analysis of DNI scores based on drug death and arrest rates in all counties in the United States for the period 1994-2000, we found that Baltimore City had the highest DNI score in the country except for a small county in Utah with 756 residents whose DNI score was not reliable. The other nine counties with at least 10,000 residents that had national DNI scores as high or nearly as high as Baltimore City's were three in New York (Bronx, New York, and Kings County) and one each in New Mexico (Rio Arriba), New Jersey (Essex County), California (San Francisco County), Colorado (Denver County), Virginia (Richmond City) and Missouri (Saint Louis City). In part, Baltimore City's high rate reflected its exclusively urban composition and the fact that most of the other high-rate urban areas were in counties that included suburban or rural segments (e.g., Cook County, Illinois). Washington, DC, was not included in the national county analysis. When we compared Maryland's counties to all others in the country, the only other Maryland counties with DNI scores that were in the top 200 during 1994-2000 were Worcester, Dorchester, and Cecil Counties, with ranks of 25th, 80th , and 172nd highest in the nation respectively. In that study, the DNI distribution was also skewed, with a mean of 13.6 and a median of 11.8. In the national SNI distribution, Baltimore City ranked 15th with a SNI score of 82, while Worcester County ranked 18th with a score of 76. No other Maryland County ranked in the top 200 SNI scores. It should come as no surprise to anyone that the need indexes would find that the country has a relatively small number of hot spots, while the rest of the counties have relatively low or moderate levels of drug and alcohol problems.

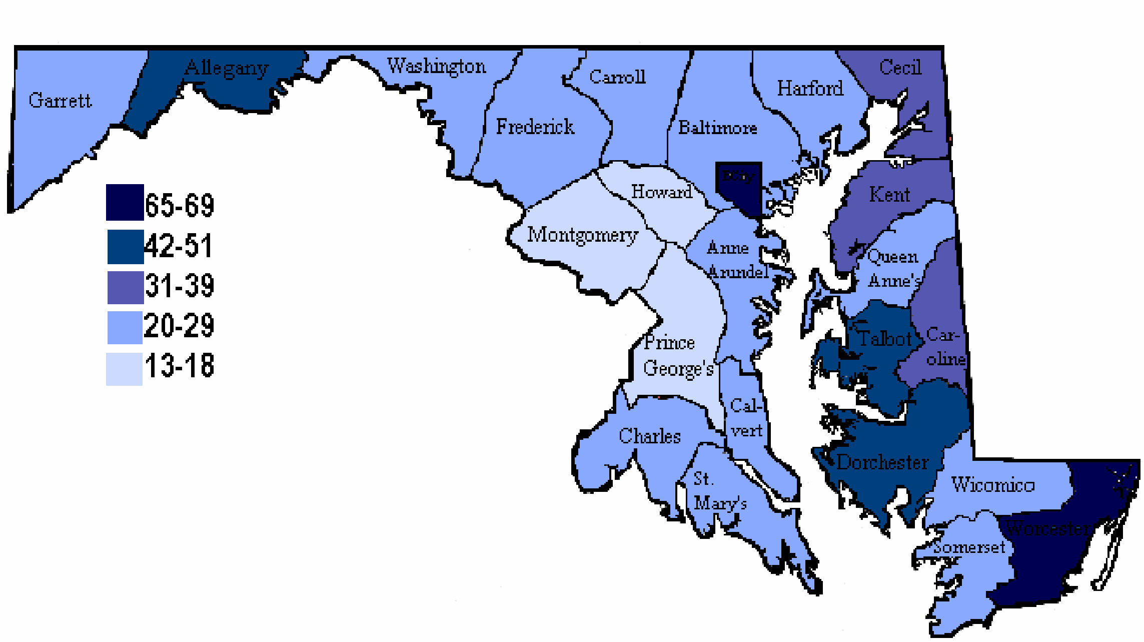
Another question asked by many is that Prince George's County had the 6th lowest DNI score in the state. The DNI score (9) represented the average of a somewhat mixed picture of drug indicators. The county had the state's 2nd lowest drug arrest rate, 6th lowest drug hospital discharge rate, and 12th lowest drug mortality rate, which was just below the state median. The NSDUH 2005-2006 survey estimate of past-year diagnosis of illicit drug abuse or dependence for the county was 1.7%, which was lower than the survey's other three county-level estimates for Montgomery County (1.9%), Anne Arundel County (2.2%), and Baltimore City (5.1%). The same survey in 2002-2004 found that Prince George's drug abuse and dependence percentage (2.85%) was lower than Anne Arundel County's (2.91%) and Baltimore City's (3.08%), but was higher than Montgomery County's (2.29%). By contrast the moderate to low ranks of those indicators, Prince George's county's AIDS rate associated with injection drug use ranked second highest in the state, and the syphilis rate ranked third highest. The impact of the AIDS rate most likely accounts for the drug mortality rate's being at the median. The syphilis rate is often correlated with cocaine abuse and heroin injection drug use. Arrests for robbery and prostitution, which are commonly associated with drug abuse, were 7th and 11th highest respectively. The county's median income was slightly above average, and the percentage of its residents in poverty was about average. Like its mixed indications of need, Prince George's County's drug treatment admission rates in hospital and non-hospital settings were mixed: 11th and 23rd respectively.

Figure 15: County Drug Need Index Scores



The ANI scores ranged from 69 to 13, with a mean of 31.0 and a median of 26.7. As common sense suggests, county alcohol treatment needs were much less skewed than were drug treatment needs (skew of 1.5 versus 4.1). While Baltimore City's ANI of 69 was the state's highest, it was not an outlier far from the other scores, as was the City's DNI score. The second highest ANI score was Worcester's (65). The two next highest ANI scores were also on the Eastern Shore: Dorchester (51) and Talbot (42). The lowest ANI scores were in the suburban counties of Montgomery (13), Howard (16), Prince George's (18), Carrol (20), and Charles (20). Comparison of the ANI scores and the primary alcohol treatment admission rates suggested a lower degree of convergence than for the DNI and primary drug treatment admission rate (Table 5). High and low rates of primary alcohol admissions can be found throughout the ANI range. The Pearson correlation between the ANI and alcohol treatment admissions was half as large as the correlation between DNI and drug treatment admissions (.48 vs .93). The Spearman rank order correlation between the ANI and alcohol treatment admissions rate was .60. The biggest disparity between alcohol treatment need and primary alcohol admission rates was in Baltimore City, whose ANI ranked 1st and whose alcohol treatment admission rate ranked 17th in the state. This result suggests that Baltimore City's efforts to cope with the drug problem may have overshadowed the unmet need for alcohol treatment services.

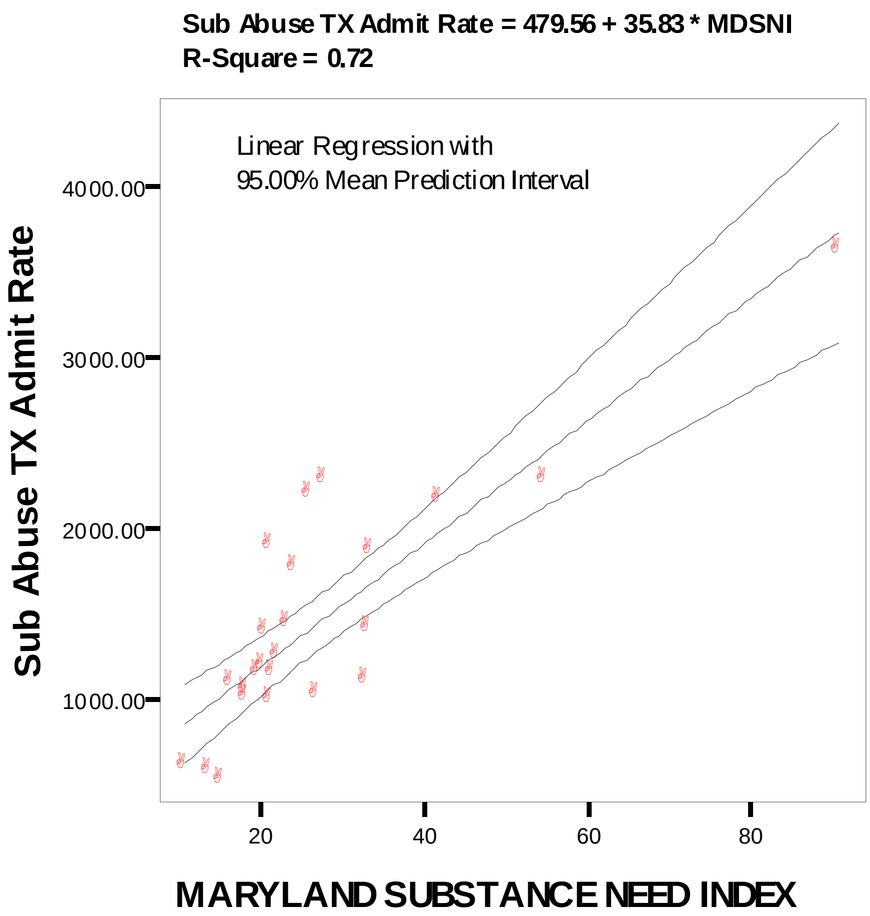
Figure 16: County Alcohol Need Index Scores



Treatment Gaps

As noted above, the geographic distribution of substance abuse treatment services in Maryland is reasonably consistent with the distribution of substance abuse treatment needs. Although the correlation between the SNI and total treatment admissions indicates that state residents are likely to obtain substance abuse treatment services in counties where they are most needed, the disparities between the SNI scores and the total treatment admissions for some counties indicate that there is room for improvement in the allocation process. Gaps may be reduced by allocating additional publicly-funded admissions and encouraging increases in privately-funded services (such as working with providers and community leaders to open new private facilities in areas with high levels of unmet need).

Figure 17. MD Substance AbuseTreatment Gaps 2001-2005



To estimate the size of the gaps, the study used regression analysis. The scatter plot in Figure 17 describes the regression line and fit of the observed total substance abuse treatment admission rates as predicted by Substance Abuse Need Index (SNI) scores. The center of each circle is the intersection between the county's observed total substance abuse treatment admission rate and its SNI score. The regression line is the best-fitting straight line to summarize those points based on the minimal sum of the squared vertical deviations of the observed values and corresponding points on the line. The line describes the average relationship between the county level of treatment needs as measured by the SNI scores and the treatment admission rates. The vertical difference between the admission rates predicted by the regression line and the observed admission rate measures the extent to which a county's residents received treatment compared to their need for treatment (Table 6). When the deviation in the amount is negative, it is called a "treatment gap."

Table 6. Total Substance Abuse Treatment Gaps: Differences Between Observed and Predicted Total Substance Abuse Treatment Admission Rates Per Annum 2001-2005, and Recommended Increases

County	Substance Abuse Need Index (SNI) Scores	Observed Total Substance Treatment Admission Rates per 100,000	SNI Predicted Substance Abuse Treatment Admissions Per 100,000	Treatment Admission Gaps per 100,000 (Observed Minus Predicted)	Increase in Total Annual Treatment Admissions per Annum	Increase in Public Treatment Admissions Per Annum at Current Public/ Private Mix
Prince George's	15	524	1,017	-493	4,098	2,198
Baltimore County	27	1,012	1,446	-434	3,358	1,554
Montgomery County	11	612	865	-254	2,318	1,271
Howard	14	571	969	-397	1,045	507
Baltimore City	91	3,613	3,729	-116	741	425
Harford	21	985	1,234	-249	575	243
Anne Arundel	21	1,147	1,248	-101	511	234
Allegany	33	1,102	1,679	-550	406	367
Fredrick	18	1,008	1,128	-120	254	125
Cecil	33	1,408	1,667	-259	240	181
Carroll	18	1,053	1,130	-76	124	70

Table 6. Total Substance Abuse Treatment Gaps: Differences Between Observed and Predicted Total Substance Abuse Treatment Admission Rates Per Annum 2001-2005, and Recommended Increases

County	Substance Abuse Need Index (SNI) Scores	Observed Total Substance Treatment Admission Rates per 100,000	SNI Predicted Substance Abuse Treatment Admissions Per 100,000	Treatment Admission Gaps per 100,000 (Observed Minus Predicted)	Increase in Total Annual Treatment Admissions per Annum	Increase in Public Treatment Admissions Per Annum at Current Public/ Private Mix
Worcester	55	2,276	2,436	-160	77	63
Washington	22	1,248	1,266	-18	25	17
Saint Mary’s	20	1,186	1,210	-24	22	20
Garrett	20	1,139	1,182	-43	13	12
Charles	16	1,094	1,070	24	-32	-26
Dorchester	42	2,158	1,978	180	-55	-45
Talbot	34	1,857	1,680	177	-62	-48
Queen Anne’s	21	1,391	1,219	172	-75	-62
Calvert	23	1,432	1,316	116	-97	-77
Caroline	24	1,751	1,338	412	-127	-109
Kent	28	2,267	1,478	788	-155	-140
Somerset	21	1,885	1,240	645	-164	-142
Wicomico	26	2,184	1,405	779	-681	-484

The positive differences between the observed and predicted admission rates are relative to the average rates of other counties in the state. They are not absolute differences between need and service. Although nine of the counties had observed rates that exceeded the predicted rates, it would be incorrect to assume that these values indicate that there were too many treatment admissions in those areas. State and federal surveys of state residents, including Maryland’s needs assessment surveys, have concluded that there are substantial absolute deficits in the supply of services in Maryland and every other state in the nation. The last statewide needs assessment telephone survey conducted in Maryland estimated that 5.6% of the state’s household population aged 18 years or older had a substance use disorder (Petronis and Wish 1996). NSDUH face-to-face interview data collected in Maryland from 2005-2006 indicated that 7.7% of the state’s population aged 12 and older currently had a substance use disorder (Office of Applied Studies 2007). The estimated percentage for

Baltimore City was 11%. By contrast, the average percentage of Baltimore City's residents receiving substance abuse treatment in 2001-2005 was 3.6%, and the median county percentage in substance abuse treatment was 1.3%.

The counties that needed the largest increases in their total public and private treatment admissions per year were Prince George's (4,098), Baltimore County (3,358), Montgomery (2,318), Howard (1,045), and Baltimore City (741). When considering only admissions to facilities that received public funding, those five jurisdictions continued to be more in need than any others. There was a substantial decline in the number of needed public admissions in the remaining counties that had treatment gaps. Of course, population size was an important contributing factor in those determinations, as the largest per capita treatment gap was in Allegany County (550 admissions per 100,000). The percentage mix of public and private admissions also played a role in determining the number of needed public admissions, and that mix could change as a result of future allocations.

Sensitivity Analysis. To determine how robust the regression results were, we conducted a sensitivity analysis that is described in Appendix C. It found that exclusion of the outlier Baltimore City from the analysis resulted in small changes in the regression parameters but a non-trivial change in the estimated unmet needs for Baltimore City if the new equation was applied to Baltimore's SNI and treatment admission rate. The treatment gap for Baltimore City increased from 116 to 364 per 100,000. The only other county with a substantial change was Worcester County (160 to 276 per 100,000). We concluded that further research should be conducted to investigate the hypothesis that the regression-estimated unmet needs for treatment in Baltimore City and Worcester County were smaller than they should have been due to technical aspects of the least squares methodology. In the meantime, the state may wish to give these two hotspots the benefit of the doubt by using their estimates from this sensitivity analysis.

We also examined the possible effect of assuming that the regression intercept passed through the origin. That change had a much more profound effect on the gap estimates (See last column of Table 8 in Appendix C). An SNI of zero is outside of the range of experience. As shown in Table 5, the counties (Montgomery, Howard, Prince George's, and Charles) with SNI values that are not far from zero nevertheless had fairly substantial treatment admission rates. Counties that had no drug deaths nevertheless had a substantial number of drug treatment admissions. National substance abuse surveys have found that respondents that did not meet criteria for having a substance use disorder accounted for a substantial proportion of the nation's substance abuse treatment admissions. People with relatively mild substance use disorders may not have a fatal overdose, have a medical complication requiring hospitalization, or break the law frequently enough to get arrested. Yet they may seek treatment or be referred to treatment by a concerned employer or parent before more severe consequences occur. We concluded that there is insufficient theoretical or empirical justification for assuming that an SNI score of zero would necessarily imply no treatment services. To improve the sensitivity of the need index, we recommend adding survey data which would be likely to identify less severe substance use disorders.

Use of the Need Indicators in Allocating Future Treatment Increases

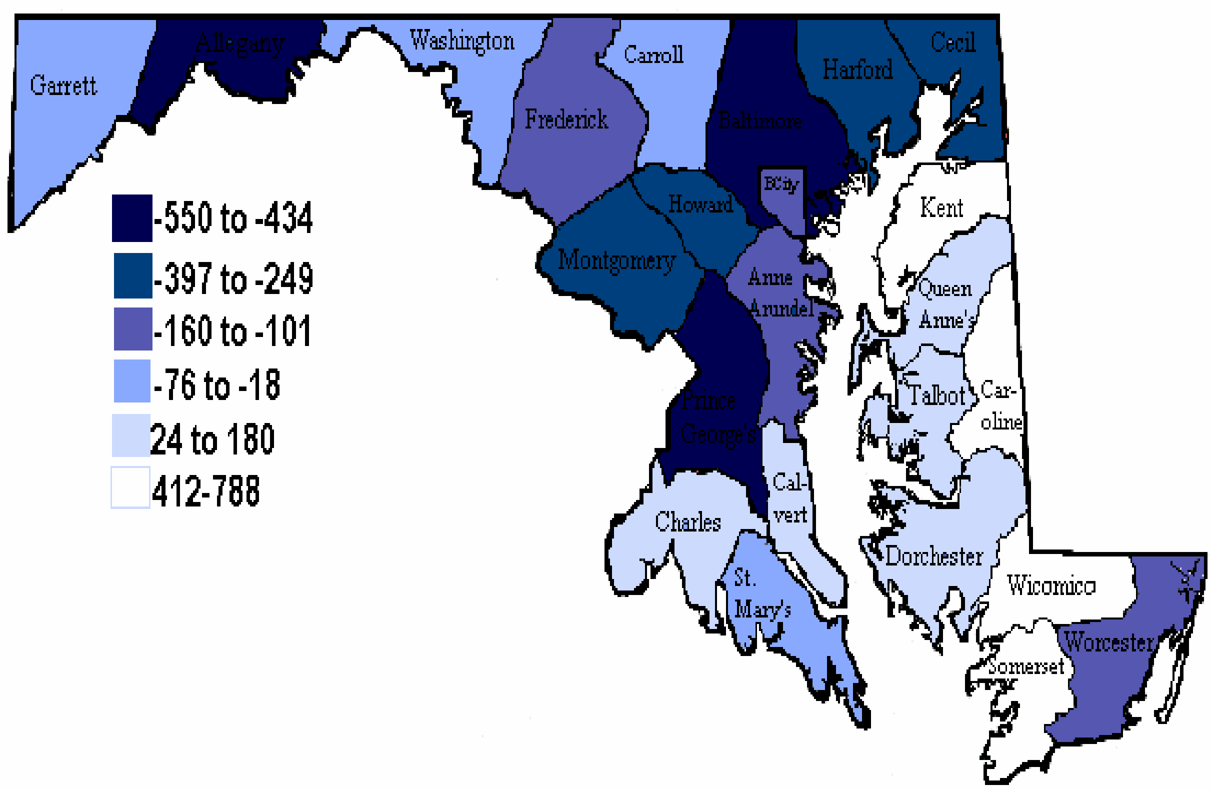
The treatment gap estimates in Table 6 were developed as an objective basis for the allocation of additional treatment resources that may become available in the future. The table presents the county SNI score, the total substance abuse treatment admission rates per 100,000, the estimated admission rates predicted by the SNI scores, the treatment gaps measured by the difference between the predicted rates and the observed rates, the total number of admissions per year that would be needed to close the gaps (the variable used to sort the table), and the estimated number of admissions in facilities that receive funding from the state. The last column's estimates assumed that the proportion of total admissions that were to facilities which received state-funds applied to the new admissions needed to close the gap. This assumption was reasonable because the correlations between adjacent years in the percentage of admissions that were in programs receiving some public funding ranged from .96 to .99 in 2001 to 2005, and Cronbach alpha reliability of the five year average percentage was .99.

In the first row, Prince George's County had an SNI of 15, which was the third lowest in the state, and the lowest substance abuse treatment admission rate of 524 per 100,000. According to its SNI, the predicted substance abuse treatment rate was 1,017 admissions per 100,000. As a result, the county treatment gap was minus 493 admissions per 100,000. With a mean population of 831,000, Prince George's county would have to add 4,098 new admissions per year to close the gap—an amount that is slightly less than the 4,580 admissions observed in the county during 2005. That is, the county's total number of admissions per year would have to nearly double to close the estimated treatment gap. In 2001-2005 the percentage of Prince George's treatment admissions to state-funded facilities was 53.6%. Assuming that 53.6% of the new admissions needed to fill the estimated gap would be in publicly-funded facilities, the state should aim for at least 2,198 new admissions of residents of Prince George's County to publicly-funded facilities. In 2007, Prince George's County returned more than $700,000 in state funds, more than 6% of its overall funding (Helderman 2008). The county has a shortage of residential beds and trained counselors. While capital investments, training of staff, and more effective use of existing allocations would reduce the current gap, it would not be enough on its own to close the gap. Privately-funded treatment admissions must be increased to make up the remainder of the gap by encouraging private treatment agency officials to expand existing county programs and improving private referral networks. Officials explained that the county has far fewer doctors than other counties, and in turn there are fewer referrals for treatment. If efforts to increase admissions in programs wholly dependent on private sources are ineffective, the state as the funding source of last resort could increase the percentage of admissions in the county to facilities that are state funded.

The other counties with treatment gaps were Baltimore County (needing 1,554 additional admissions to publicly-funded programs), Montgomery (1,271), Howard County (507), Baltimore City (425), Allegany (367), Harford (243), Anne Arundel (234), Cecil (181), Fredrick (125), Carroll (70), Worcester (63), Saint Mary's (20), Washington (17), and Garrett County (12) (Table 6; Figure 18). If the state decided to use Baltimore City's gap estimate of 364 admissions per 100,000 from the sensitivity analysis in Appendix C, closing its overall treatment gap would require an additional 2,335 total admissions per year, of which 1,338 would be in programs that received public funds. The needed increase in public admissions for Worcester County would be 108 admissions rather than 63.

Except for Baltimore City (SNI=91), Worcester County (55), Cecil (33), and Allegany (33) County, the counties with treatment gaps did not have SNI scores above the mean (27), but compared to other counties they did have relatively low levels of treatment admissions and the lowest proportions of their admissions were publicly funded. Baltimore City had both the highest level of need and the highest rate of treatment services, but its total services did not meet the level that would be expected based on its SNI score. The proportion of Baltimore City's admissions that were publicly funded was the ninth lowest in the state (57%). Counties with the largest treatment admission rates relative to their predicted rates were on the Eastern Shore: Kent and Somerset counties. They had moderately high levels of need but also had high levels of treatment admissions per 100,000. In Western Maryland, Allegany, Fredrick, Garrett, and Washington Counties had treatment gaps, with the largest gaps in Fredrick and especially Allegany County (550 admissions per 100,000). The four western counties had moderate levels of need (ranging from 6th highest to 20th highest), yet in all but Washington County the total treatment admission rates were below the median. In most cases, the counties with more admissions than predicted by the regression (positive residuals) were on the Eastern Shore, had relatively small populations, and had small numbers of current treatment admissions.

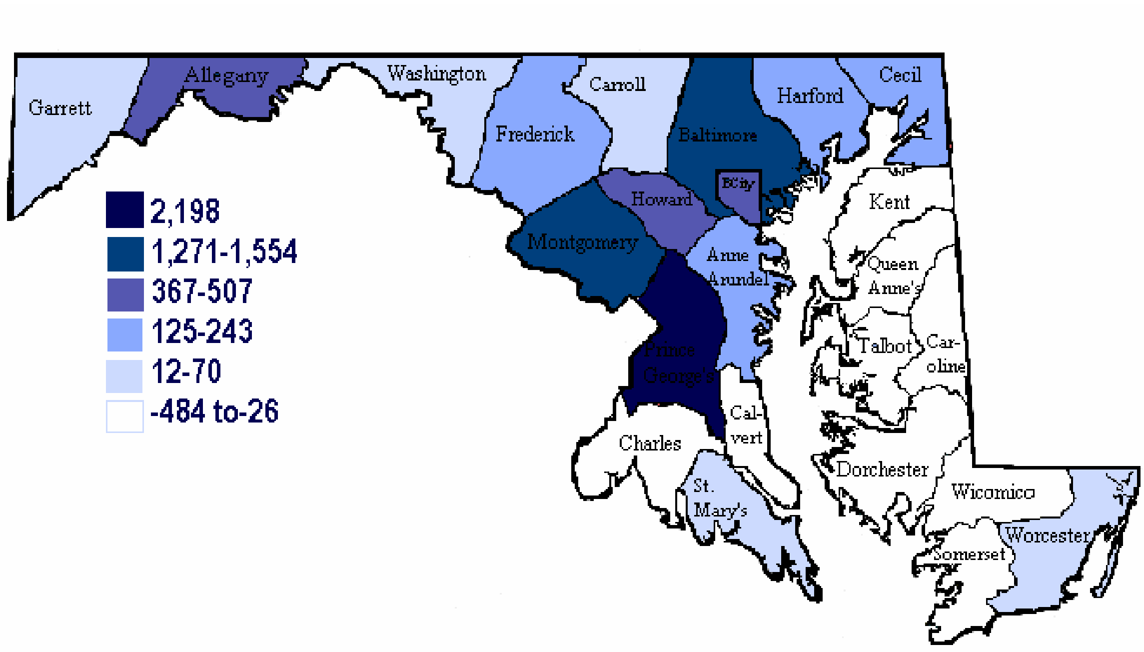
Figure 18: County Total Treatment Admission Gaps per 100,000 Population



The treatment gaps were not generally where one might expect (Figures 18 and 19). Figure 19 depicts where the admissions to publicly-funded facilities should go if new services were allocated by need rates and population size based on the gap estimates in Table 6. With the exception of Baltimore City, the counties that would receive the largest number of public admissions were not ones that are generally associated with poverty or high rates of drug addiction. Rather, they are counties whose admissions in publicly-funded facilities were especially low.

In order to eliminate the negative treatment gaps in Table 6, the state would have to increase the number of admissions in programs that receive public-funding by 7,287 admissions. (An additional 1,446 admissions up to 8,733 would be required if the sensitivity analysis were used for Baltimore City and Worcester County.) The 8,733 would represent an 18.5% increase in the 47,122 publicly-funded admissions in Fiscal Year 2007.

Figure 19: Number of County Public Treatment Admissions Needed to Fill Gaps



SUMMARY AND CONCLUSIONS

The Maryland legislature has indicated its desire to understand the current treatment needs of the state and its counties. The Alcohol and Drug Abuse Administration (ADAA) commissioned this study of county treatment needs from the Center for Substance Abuse Research (CESAR). The study developed a composite index of the relative level of substance abuse treatment need. The Substance Need Index (SNI) and counterpart drug and alcohol need indexes (DNI, ANI) used multiple quantitative indicators of serious substance-use disorders: mean rates of drug- and alcohol-related mortality, hospital discharges, and arrests for 2001 to 2005. The SNI scores were nominally unweighted sums of standardized substance (drug and alcohol) abuse indicator rates. We employed the SNI as the independent variable in a bivariate regression equation to estimate county gaps in treatment services. The dependent variable was the mean annual county rates of substance abuse treatment admissions for the same time period.

The SNI's component need indicators were substantially reliable and valid. The data sets had little missing data and few obvious errors. Not all states are as fortunate as Maryland in this regard, which has led to some of the negative conclusions regarding substance abuse indicators that have appeared in the literature (DeFleur 1975). We used five years of data to ensure that the county-level estimates, especially for small counties, had a high level of reliability. Reliability estimates measured by Cronbach's alpha were .99 for the substance abuse arrest, hospital-discharge, and treatment-admission rates. The alpha estimate for the five-year substance mortality rates was .94. These results indicate that only small proportions of the rates were due to random errors because of small populations, inconsistent reporting, or local variations in the application of diagnostic codes or drug crack downs. The drug need indicators had strong evidence of convergent validity, although the very high level of agreement among the indicators declined somewhat when the effects of Baltimore City's extreme values were minimized in the Spearman Rank Order correlations. There was evidence of convergent validity for alcohol mortality and hospital discharge rates, while such evidence was limited for alcohol arrest rates. Despite the lack of correlation between alcohol arrest rates and the other two alcohol need indicators, the ANI performed more validly with alcohol arrests included. There were also theoretical and methodological reasons for including the alcohol arrest indicator. Maryland's indicator reliability and validity analyses produced results similar to findings in Rhode Island and Massachusetts (McAuliffe 2005; McAuliffe et al. 2002).

The composite need indexes also had evidence of reliability and construct validity. The SNI's internal-consistency reliability as measured by Cronbach's alpha was .88. The 2001-2005 version of the SNI correlated .92 with a 1994-2000 version based on deaths and arrests, thus indicating a high level of stability and test-retest reliability. Analyzing the correlations of the need indexes with other direct and indirect indicators, the study found evidence of construct validity for both the DNI and the ANI.

All of the indicators examined showed that counties varied substantially in the extent of their drug and alcohol problems and treatment admissions. The drug and alcohol arrest rate in Worcester County was nearly eleven times higher than the rate in Prince George's County, and Baltimore City's drug and alcohol mortality rate was eight times higher than Montgomery County's. The rate of hospital discharges following treatment for complications of drug or alcohol abuse was eleven times higher in Baltimore City than in Garrett County. Although the ratio of the largest to smallest county treatment admission rates was somewhat smaller than the need indicator ratios, there was a seven-fold difference between the highest and lowest county substance abuse treatment admission rates in Maryland. These ratios reflected the presence of outliers in all of the indicators, but there was still considerable variation when the outliers were trimmed from the data. Moreover, these outliers were not the result of measurement errors; they were reflections of the extreme values in some of the state's counties in their substance abuse rates. Clearly, these large variations in need and treatment indicators are not consistent with the assumption that a constant percentage of every county's population has drug or alcohol problems. Within the regions created by the NSDUH for Maryland, drug and alcohol indicator rates varied widely. Consequently, the common practice of applying the NSDUH's regional estimates to all counties within the regions misses important county differences in treatment need.

Comparing indicators of drug and alcohol treatment needs (deaths, arrests, and hospital discharge rates) with drug and alcohol treatment admission rates revealed a discrepancy in the amounts of alcohol versus drug treatment services. Even though the number of deaths, arrests, and hospital discharges stemming from alcohol use exceeded the number stemming from drug use, there were more primary drug treatment admissions than primary alcohol treatment admissions. We have found the same result in the country as a whole and other East Coast states such as Massachusetts and Rhode Island (McAuliffe et al. 2002, 2003; McAuliffe and Dunn 2004; McAuliffe 2005).

The Substance Need Index (SNI) provides decision makers with an objective composite scale of the severity of substance abuse in the state's counties between 2001 and 2005. In theory, the SNI could range from 0 (no serious indications of substance abuse) to 100 (all indications were the highest observed values in the state). The actual SNI scores were consistent with expectations. Baltimore City's SNI score of 91 was the highest, much higher than any other county. The mean SNI was 27, and the median SNI was 22. The SNI scores were lowest in suburban counties (Montgomery 11, Howard 14, Prince George's 15, and Charles 16). Counties west of Baltimore County had below average SNI scores (Fredrick 18, Carroll 18, Garrett 20, and Washington 22). The western tidewater counties of Harford (21), Baltimore (27), Anne Arundel (21), Calvert (23), and St. Mary's (20) had moderate to moderately low SNI scores. Counties with moderate to moderately low SNI scores on the Eastern Shore were Kent (28), Queen Anne's (21), Caroline (24), Wicomico (26), and Somerset (21). Perhaps the most surprising findings were the above average SNI scores for the four Eastern Shore counties of Worcester (55), Dorchester (42), Talbot (34), and Cecil (33), as well as for Allegany County (33) in Western Maryland.

The greatest advantage to having a validated index of need was being able to relate it to the level of treatment services quantitatively. There was a good match between county treatment need and service rates during the study period. The SNI explained 72% of the variance in the total substance abuse treatment admission rates. The amount of explained variance declined to 45% when Baltimore City was removed. These results suggest that state's treatment system delivered services where they were needed to a reasonable degree.

Admission rates in some counties were lower than predicted by their SNI scores. The areas of greatest unmet need were the suburban counties outside of the District of Columbia, Baltimore County and the surrounding counties of Anne Arundel, Harford and Carroll counties, Baltimore City, western counties, and Cecil County. Among the seven counties with the largest treatment gaps were four (Prince George's, Montgomery, Howard, and Harford) with SNI scores below the median, but they also had especially low levels of treatment admissions. Prince George's County is a good example. Its alcohol treatment admission rate was especially low. Because many of the residents in need from these counties were not poor, they often obtained treatment proportionately more from programs that depended entirely on private funds. However, it is not unusual for suburban areas to have a shortage of needed public services, due in part to service allocations lagging behind in urban migration trends and the reluctance of suburban communities to place substance abuse treatment facilities near middle class residential neighborhoods (Malarkay 2006). Throughout the nation, cases of drug dependence involving prescription opioids have increasingly occurred in rural and suburban areas that heretofore were free of severe illicit opioid abuse problems (Fingerhut 2006), but often residents have resisted having methadone programs in their areas even though there is now a documented need for such services (Everline 2000; Adamsson 2003). Research suggests that patients are less likely to seek treatment and remain enrolled if the treatment facilities are far from home (Beardsley et al. 2003; Schmitt et al. 2003).

Despite an increase from $18 million to $53 million in funding for Baltimore City's drug treatment services between 1996 and 2005, those services do not quite meet the level that would be expected based on its SNI score (Ericson 2006: Baltimore City Health Department 2006). Baltimore City has the highest rate of need and the highest rate of both publicly- and privately-funded treatment services in the state and has one of the highest rates of drug problems in the nation. In two studies of Rhode Island, McAuliffe et al. (1991, 2002) found that Providence had more admissions than predicted by its estimates of need (survey in one study and indicators in the other). A recent study of Massachusetts found that Boston and surrounding towns also had relatively more services than the composite index scores suggested were needed (McAuliffe 2005). However, in an unpublished study of treatment needs in Illinois, McAuliffe found that Chicago (Cook County), like Baltimore City, had the highest rates of need and admissions, but was still underserved relative to other counties.

Because Baltimore City was an outlier and could therefore be expected to influence the regression estimates for technical reasons, we estimated the regression equation after trimming Baltimore City from the data set. The primary effect was to increase the City's estimated treatment gap from 116 to 364 per 100,000 admissions. We recommended that further research be conducted by the state to determine if Baltimore's treatment gap was underestimated by the primary regression equation.

To illustrate the treatment need index's possible use in service allocations, the study developed estimates for closing county treatment gaps. Evidence from previous surveys of state needs and services indicates that the absolute amount of unmet treatment need throughout the state is so great that our plan reduced no county's services from current levels. To obtain recommended allocations, we multiplied the total treatment gap in admissions per 100,000 by the county's population size in 100,000 units. The ten largest recommended increases in annual treatment admissions were, in order, for Prince George's County (2,198), Baltimore County (1,554), Montgomery County (1,271), Howard County (507), Baltimore City (425), Allegany County (367), Harford County (243), Anne Arundel County (234), Cecil County (181), Fredrick County (125), and Carroll County (70). (Baltimore City's estimated unmet need for public admissions would be increased by more than three fold to 1,338 if the sensitivity analysis regression that excluded Baltimore City were assumed to be the most accurate.) If all of the negative gaps were completely eliminated so that these counties had treatment admissions rates consistent with their needs, an additional 14,423 admissions per annum would be required. If the proportion of public and private funding in each county remained unchanged, an additional 7,287 admissions in state-funded facilities would be needed. Another

1,446 admissions would be needed if the sensitivity analysis estimates for Baltimore City and Worcester County were used instead, increasing the total public admissions to 8,733. This amount would represent an 18.5% increase in the 47,122 admissions to publicly-funded facilities in 2007 (Maryland Alcohol and Drug Administration 2008). Because the required increase is substantial, the recommendations could be implemented over a period of years.

DISCUSSION, LIMITATIONS, AND RECOMMENDATIONS FOR FUTURE RESEARCH

The state of the art and science of treatment needs assessment has not benefited from a large amount of research and practical experience. The authors recommend that the state proceed with suitable caution when applying this new needs assessment methodology in Maryland.

The process of developing the Maryland Substance abuse Need Index has included evaluation of reliability and validity at every step, but the final step of validating the study's recommendations remains to be done. Although the estimates of reliability and validity have been encouraging, all data have limitations. For example, ADAA's definitions of public and private admissions were not ideal for this study. The ADAA treatment admissions data do not include self help attendance, treatment by private physicians, psychiatrists, social workers, pastoral counselors, and other non-specialty providers who nevertheless treat many cases of substance use disorders (Zarkin et al. 1995). The state statistics also do not include treatment services obtained by Maryland residents in neighboring states and the District of Columbia.

Despite the rigorous methods that we used to assess the accuracy of the data submitted to us, we were not always able to identify data errors. After the study was completed and the final report submitted, Howard County officials raised questions about the accuracy of admissions statistics used for it in the study. State officials examined the original data and found that an error had been made for all six years of data submitted to the study for analysis. The state provided the study with revised statistics for Howard County. The state also reviewed its admissions statistics for the other counties and found that they were accurate. This revised report presents our updated results.

In past research, we have used several approaches to evaluating recommended allocations of treatment services. In a Massachusetts needs assessment, McAuliffe et al. (1986) learned from analysis of treatment admission data that residents of areas where services were in short supply drove an hour each morning for methadone to a town where services were more prevalent. If new services were made available in the underserved area, a decline in the number of such clients would be an indication that unmet needs were being met (Brands et al. 2002; McAuliffe et al. 1991). A similar study in Maryland would be a valuable extension of this study. In a study of drug treatment needs in Rhode Island, McAuliffe et al. (1991) found that new facilities in areas identified as in great need quickly filled all of their new treatment openings. In the next couple of years, Maryland could use the results of this study to provide additional treatment funding to the counties identified as being most in need. Rapid absorption of the new services would confirm the extent of unmet need. A study comparing the gap estimates with occupancy rates and waiting lists, while an old, inferior method of measuring unmet demand, would nevertheless be useful as part of the validation process.

Consulting with service providers, county service coordinators, referral personnel in drug courts and other agencies, and ADAA's regional staff is often valuable as part of the validation of any service need recommendations. These professionals are faced with the problems of inadequate services on a daily basis, and their judgments have always had an important role to play in the treatment allocation process. They can provide information on how the gaps may be most fruitfully closed. Regional presentations of the results may be a valuable tool, both to evaluate the model and promote its acceptance in the field.

Although we have made every effort to include the most valid indicators in the need indexes and have found solid evidence that they possess substantial reliability and validity, individual values of components may contain error variance. Validity and reliability are proportion of variance measures, not all or nothing concepts. It is possible, for example, that residents of some counties travel to other states or the District to obtain hospital treatment or substance abuse treatment services, to die, or to commit crimes, and those events were not counted in the county's index score or dependent variable. More than three-quarters (18) of the counties border another state, and nearly all of Maryland's counties are within a relatively short ride from a state border. We currently have no means for determining how often such events occur in every county. If such measurement errors were truly common, the evidence on convergent and construct validity would not have been so favorable. Also, that error may occur on both sides of the equation (needs and services). We compared the components of the need indexes with other direct and indirect drug and alcohol indicators for several counties, such as Montgomery, Prince George's, Garret, and Cecil Counties. We found no obvious evidence that the indicators (e.g., hospital discharges) were lower than one would expect relative to the other measures. Trying to collect direct information on this potential error was beyond the scope of the present study, but the state may wish to conduct follow-up research on that topic.

We recommend further research on measurement of treatment need in vacation areas, in particular on the arrest rate components of the need indexes. In Rhode Island, we experimented with using monthly data to remove the excess of drug and alcohol arrests in its many vacation areas, such as Newport. The method was incomplete because increases in arrests during summer months were also common in many non-vacation areas. Also, states often increase treatment services in vacation areas during the summer months to service the substance abuse treatment needs created by visitors and seasonal workers. Future efforts to refine the Maryland methodology should include research on whether a valid method could be developed to adjust the arrests in vacation areas.

A potentially important enhancement of the SNI in the future would be to add survey estimates as a fourth need indicator. Substance abuse surveys are especially useful for identifying relatively mild forms of substance use disorders. For example, a large percentage of drug use disorders in the NSDUH are associated with marijuana use. At present there are no suitable substance abuse survey results for Maryland's counties. The NSDUH's substance use disorder estimates for the state's sub-areas are based on small samples and consequently are not reported at the county level, and the NSDUH includes treatment admissions as an independent variable in their estimation model. The presence of admissions invalidates the NSDUH estimates in an index of treatment need that seeks to be independent of current treatment utilization. School surveys, designed primarily for prevention planning, cover only a small part of the relevant population, and the annual Maryland BRFSS telephone survey currently lacks measures of substance use disorders or treatment needs. Woerle et al. (2007) recently published a pioneering BRFSS survey that included a module designed to measure alcohol dependence. McAuliffe is currently building upon that work by creating a module for Massachusetts that covers drug and alcohol abuse and dependence. The results so far are promising. Maryland should consider a similar substance use disorder module for its annual BRFSS survey, which had a sample of 8,800 interviews in 2006. Within three years the state could accumulate 25,000 interviews. The resulting three-year survey estimates of substance use disorders could contribute importantly to the treatment need indexes.

Finally, the current regression model parameters are likely to change during the process of closing treatment gaps. With virtually no research in the field on the functional relationship between aggregate need and service utilization, the current model descriptively summarizes the existing system of public and private services and the many historical and environmental forces that shaped it. The regression is not a normative model that embodies an ideal relationship between need and treatment services–which is currently unknown. For example, the correlation results in Table 3 show that the best predictor of treatment admissions currently is arrest statistics. The SNI implicitly gives slightly less effective weight to arrests (30% of the SNI variance) than to either deaths or hospital discharges (36% and 34% respectively). Using the SNI as a guide to increasing services would therefore result in a modified relationship between need and treatment admission rates. As new allocations diminish the large treatment gaps in Baltimore City and County, as well as Prince George’s, Montgomery, Howard, Harford, Anne Arundel, Allegany, Fredrich, Cecil, Carroll, Worcester, Washington, St. Mary’s, and Garrett counties, the parameters of the relationship between the SNI and total admissions are likely to strengthen and change functionally.

APPENDIX A.

Diagnostic and Procedure Codes from the International Classification of Diseases, Revision 10 (ICD-10) for Mortality; Revision 9 Clinical Modification (ICD-9-CM) For Hospital Discharge Data

Codes Used for Mortality Data

The Maryland Vital Statistics Administration used the International Classification of Diseases, 10th Revision (ICD-10) for coding deaths in Maryland during 2001-2005. A decedent qualified as an explicit-mention alcohol death if the death certificate contained at least one of the following ICD-10 diagnostic codes in a multiple cause field: (1) acute alcohol intoxication (F10.00-F10.07); (2) harmful alcohol use (F10.1); (3) alcohol dependence syndrome (F10.20-F10.26); (4) alcohol withdrawal state (F10.30-F10.31); (5) alcohol withdrawal state with delirium (F10.40-F10.41); (6) alcohol psychotic disorder (F10.50-F10.56); (7) alcohol amnesic syndrome, or Korsakov's psychosis/syndrome (F10.6); (8) residual and late-onset alcohol psychotic disorder (F10.70-F10.75); (9) other mental or behavioral disorder resulting from alcohol use (F10.8); (10) unspecified mental or behavioral disorder resulting from alcohol use (F10.9); (11) degeneration of the nervous system due to alcohol (G31.2); (12) alcoholic polyneuropathy (G62.1); (13) alcoholic cardiomyopathy (I42.6); (14) alcoholic gastritis (K29.2); (15) alcoholic fatty liver (K70.0); (16) alcoholic hepatitis (K70.1); (17) alcoholic fibrosis/sclerosis of liver (K70.2); (18) alcoholic cirrhosis of the liver (K70.3); (19) alcohol hepatic failure (K70.4); (20) alcoholic liver disease, unspecified (K70.9); (21) alcohol-induced chronic pancreatitis (K86.0); (22) excessive blood level of alcohol (R78.0); (23) fetal alcohol syndrome (dysmorphic) (Q86.0); (24) fetus and newborn affected by maternal alcohol use (P04.3); and (25) alcohol poisonings. Alcohol poisoning cases require a combination of X (accidental poisoning and exposure) or Y (poisoning and exposure cases of undetermined intent) codes and T (toxic effects of substance) codes. Four types of alcohol poisoning cases were included in our analyses: (25a) accidental poisoning due to ethyl alcohol (X45 and T51.0); (25b) accidental poisoning due to unspecified alcohol (X45 and T51.9); (25c) poisoning due to ethyl alcohol, undetermined intent (Y15 and T51.0); and (25d) poisoning due to unspecified alcohol, undetermined intent (Y15 and T51.9). Analyzing national mortality data, McAuliffe et al. (2000) found that few alcohol poisoning deaths were coded as intentional, and we therefore assumed such alcohol overdose deaths with undetermined intent were likely to be accidental. Similarly, most alcohol poisoning deaths were due to ethyl alcohol, and we therefore assumed that unspecified alcohol was ethyl alcohol.

A decedent qualified as an explicit-mention drug death if the death certificate contained at least one of the following thirteen ICD-10 diagnostic codes in a multiple cause field (the first ten categories pertain to all drugs except tobacco [F17 codes]): (1) acute drug intoxication (F11.0-F19.0, except F17.0); (2) harmful drug use (F11.1-F19.1, except F17.1); (3) drug dependence (F11.2-F19.2, except F17.2); (4) withdrawal state (F11.3-F19.3, except F17.3); (5) withdrawal state with delirium (F11.4-F19.4, except F17.4); (6) psychotic disorder (F11.5-F19.5, except F17.5); (7) amnesic syndrome (F11.6-F19.6, except F17.6); (8) residual and late onset psychotic disorder (F11.7-F19.7, except F17.7); (9) other mental and behavioral disorders (F11.8-F19.8, except F17.8); (10) unspecified mental and behavioral disorders

(F11.9-F19.9, except F17.9); (11) neonatal withdrawal symptoms from maternal use of drugs of addiction (P96.1); (12) abnormal findings of drugs not normally found in blood (R78.1-R78.4); and (13) drug poisonings. Like alcohol poisoning cases, drug poisoning cases require a combination of X (accidental poisoning and exposure cases) or Y (poisoning and exposure cases of undetermined intent) codes and T (toxic effects of substance) codes. We included seven types of drug poisoning cases in our analyses: (13a) accidental poisoning due to barbiturates (X41 and T42.3); (13b) accidental poisoning due to benzodiazepines (X41 and T42.4); (13c) accidental poisoning due to other antiepileptic and sedative-hypnotic drugs (X41 and T42.6); (13d) accidental poisoning due to psychostimulants with abuse potential (X41 and T43.6); (13e) poisoning by and exposure to psychostimulants with abuse potential, undetermined intent (Y11 and T43.6); (13f) accidental poisoning by and exposure to narcotics and psychodysleptics [hallucinogens] (X42 and T40.0-T40.9); (13g) poisoning by and exposure to narcotics and psychodysleptics [hallucinogens], undetermined intent (Y12 and T40.0-T40.9). Analyzing national mortality data, McAuliffe et al. (1999) found that poisonings by some drugs such as barbiturates and tranquilizers are often the result of suicides, and therefore undetermined intent diagnoses involving those drugs were not assumed to be accidental overdoses. Other drugs such as cocaine or hallucinogens were rarely used intentionally to cause death, so we assumed that the cases of undetermined intent involving those drugs were accidental deaths. Poisoning deaths are a major cause of drug abuse deaths, and we concluded that too much information would be lost by ignoring opioid, amphetamine, and cocaine drug overdose deaths of undetermined intent.

Deaths which had both a relevant alcohol and drug diagnostic code were counted in both the drug and alcohol mortality indicators.

Codes Used for Hospital Discharge Data

The International Classification of Diseases, 9th Revision, Clinical Modification (ICD-9-CM) is used in hospitals across Maryland to provide diagnosis and procedure codes for individuals discharged from Maryland hospitals in 2001-2005.

Explicit-Mention Alcohol and Drug Discharges

An explicit-mention alcohol hospital discharge was designated as a case if it contained at least one of the following ICD-9-CM Nature of disease codes ("N codes") in any of 15 primary and secondary diagnosis fields: (1) alcoholic psychoses (291, including 291.0-291.9); (2) alcohol dependence syndrome (303, including 303.0-303.9); (3) nondependent abuse of alcohol (305.0); (4) alcoholic polyneuropathy (357.5); (5) alcoholic cardiomyopathy (425.5); (6) alcoholic gastritis (535.3); (7) alcoholic fatty liver (571.0); (8) acute alcoholic hepatitis (571.1); (9) alcoholic cirrhosis of the liver (571.2); (10) alcoholic liver damage, unspecified (571.3); (11) excessive blood level of alcohol (790.3); and (12) alcohol poisoning. Alcohol poisoning cases required a combination of toxic-effect-of-poisoning-diagnostic N codes and accidental external cause ("E codes"). E codes are a supplementary classification of external causes for deaths due to injury and poisoning. The following types of cases of alcohol poisonings were included in our analyses: (12a) toxic effect of alcohol and accidental poisoning by alcoholic beverages (980.0 and E860.0) and (12b) accidental poisoning by alcoholic beverages (E860.0 alone). Analysis of the discharge data in this study revealed that there were a substantial number of hospital discharge cases coded as attempted suicides by drinking alcoholic beverages. Consequently, we restricted the alcohol overdose cases to only discharges that were coded as accidental overdoses with ethyl alcohol beverages. One reason for the difference in how the mortality and hospital discharge cases were coded was our assumption that physicians in hospitals have access to the patients and can get relatively complete information on the patient's intentions, whereas persons coding overdose deaths often have little information to go on when attempting to determine the decedent's intentions.

An explicit-mention drug hospital discharge was designated as a case if it contained at least one of the following ICD-9-CM diagnostic codes in any of 15 diagnosis fields: (1) drug psychoses (292, including 292.0-292.9); (2) drug dependence (304, including 304.0-304.9); (3) nondependent abuse of cannabis, hallucinogens, barbiturates, sedatives, and hypnotics; opiates, cocaine, amphetamines and sympathomimetics; or other, mixed, or unspecified drugs (305.2-305.7; 305.9); and (4) drug poisonings. Nine categories of drugs were included as drug poisoning cases.

Poisoning cases are supposed to be coded with a combination of N codes (nature of disease) and E codes (external cause). In the case of drug poisoning, the N codes are toxic effect of the substance, and the E codes are accidental, as opposed to intentional or therapeutic. Because both codes are not always employed in the data, this study used several types of code combinations. They included: (4a) toxic effect of substance and accidental poisoning by substance (N and E codes) and (4b) accidental poisoning by substance alone (E code only). Listed below are specific toxic effects of poisoning (N codes) and external causes of injury and poisoning incident (E codes) codes for the nine drug categories included in our analyses: heroin, methadone, and/or other opiates and related narcotics (N965.0 and/or E850.0 or E850.1 or E850.2); other specified analgesics or antipyretics (N965.8 and/or E850.8); sedatives and hypnotics (N965.8 and/or E851 or E852); other gaseous anesthetics or intravenous anesthetics (N968.2 or 968.3 and/or E855.1); surface and infiltration anesthetics (e.g., cocaine) (N968.5 and/or E855.2); benzodiazepine-based tranquilizers or other tranquilizers (N969.4 or N969.5 and/or E853.2 or E853.8); psychodysleptics (hallucinogens) or psychostimulants (N969.6 or N969.7 and/or E854.1 or E854.2); parasympatholytics and spasmolytics (N971.1 and/or E855.4); and dietetics (N977.0 and/or E858.8).

Substance Abuse Treatment Received in Hospitals: Diagnostic Related Group (DRG) Codes

All of the discharge records with an alcohol or drug diagnosis fall into one of two mutually-exclusive categories: discharges following substance abuse treatment and discharges following other forms of medical or psychiatric treatment only. To avoid predicting non-hospital substance abuse treatment admissions with hospital substance abuse treatment admissions, we used only the latter cases in the need index, while the former are used only as alternative measure of treatment utilization (e.g., as a validator of non-hospital treatment admissions).

Two types of discharge codes were used to determine cases receiving substance abuse treatment during their hospital stays: Diagnostic Related Group (DRG) codes and ICD-9-CM procedure codes. Combinations of these codes were used to create the hospital treatment utilization variables.

The DRG codes have been revised because several relevant codes had become invalid and have been replaced by others. To be safe, we included both the old and new DRG codes. The old codes were: (1) abuse of dependence, left against medical advice (code 433); (2) abuse or dependence, with complication condition (434); (3) abuse or dependence, without complicating condition (435); (4) dependence, with rehabilitation (436); (5) dependence, with rehabilitation and detoxification (437). In more recent revisions of the DRG codes (e.g., DRG v12, v14, v18, CMS DRG v23), 434 to 436 have become invalid. They were replaced by: (6) alcohol/drug abuse or dependence, with complication condition (code 521); (7) alcohol/drug abuse or dependence, with rehabilitation therapy without complication condition (522); (8) alcohol/drug abuse or dependence, without rehabilitation therapy without complication condition (523).

The ICD-9-CM procedure codes that indicated alcohol abuse treatment were: (1) psychotherapy and counseling: alcohol counseling (94.46); (2) referral for alcohol rehabilitation (94.53); (3) alcohol rehabilitation (94.61); (4) alcohol detoxification (94.62); and (5) alcohol rehabilitation and detoxification (94.63).

The ICD-9-CM procedure codes that indicated drug abuse treatment were: (1) psychotherapy and counseling: drug counseling (94.45); (2) referral for drug rehabilitation (94.54); (3) drug rehabilitation (94.64); (4) drug detoxification (94.65); and (5) drug rehabilitation and detoxification (94.66).

The ICD-9-CM procedure codes that indicated substance abuse treatment were: (1) combined drug and alcohol rehabilitation (94.67); (2) combined drug and alcohol detoxification (94.68); and (3) combined drug and alcohol rehabilitation and detoxification (94.69).

APPENDIX B.

Table 7. Sources for Indicators Used in Construct Validation

Data	Unit	Years	Source of Data
Population, Including Total Projections, Counts, % Non-White	County	2001-2005 Projections; 2000 Counts	United States Census Bureau, Population Division, release date March 22, 2007. Provided by Planning Data Services of the Maryland Department of Planning; Downloads from U.S. Census Bureau, American Factfinder
Survey Estimates of Percent of Population 18+ Reporting Binge Drinking and Heavy Drinking	County	2001-2005	Maryland Behavioral Risk Factor Surveillance System (BRFSS), Maryland Department of Health and Mental Hygiene (DHMH) and Centers for Disease Control and Prevention (CDC).
Discharges Following Hospital-based Substance Abuse Treatment	County	2001-2005	Maryland Health Services Cost Review Commission (HSCRC)
Survey Estimates of Percent of 12th Grade Students Reporting Alcohol and Drug Use	County	School Years: 2000-01 2002-03 2004-05	Maryland Adolescent Surveys (MAS), Maryland State Department of Education (MSDE)
Residents of Other Non-institutionalize Group Quarters (Shelters)	County	2001-2005	United States Census Bureau, Census 2000 Summary File 1 (SF 1) 100-Percent Data
Arrests	County	2001-2005	Maryland State Police (MSP), Uniform Crime Reporting (UCR) Program, Central Records Division; Uniform Crime Reports, Federal Bureau of Investigation; Inter-University Consortium of Political and Social Research (ICPSR), University of Michigan
HIV/AIDS Data	County	2001-2005	Maryland Department of Health and Mental Hygiene (DHMH), AIDS Administration

Table 7. Sources for Indicators Used in Construct Validation

Data	Unit	Years	Source of Data
Poverty Status	County	1999	Maryland State Data Center, Maryland Department of Planning; U.S. Bureau of the Census
Median Income	County	2001-2005	Maryland State Data Center, Maryland Department of Planning; U.S. Bureau of the Census
Retail Beer, Wine, and Liquor Licenses	County	Fiscal Years 2001- 2005	Comptroller of Maryland, Alcohol and Tobacco Tax Division
Model Estimates of Percent of Population with Substance Use Disorders	Region	2002-2004 2005-2006	Substance Abuse and Mental Health Services Administration (SAMHSA), Office of Applied Studies (OAS), National Survey on Drug Use and Health (NSDUH)
Alcohol- and Drug-Related School Suspensions	County	School Years 2001-02 to 2005-06	Maryland Department of Education (MSDE), Division of Planning, Results, and Information Management (PRIM),
Vehicle Crash Data	County	2001-2005	Maryland State Highway Administration (SHA), Maryland Automated Accident Reporting System (MAARS), Traffic Safety Analysis Division, Office of Traffic and Safety
Per Capita Consumption of Distilled Spirits, Beer, and Wine	County	Fiscal Years 2001- 2005	Comptroller of Maryland, Alcohol and Tobacco Tax Division

APPENDIX C.

Sensitivity Analysis of Regression Parameters

The use of regression analysis to analyze Maryland's substance abuse treatment needs presents technical challenges because of the relatively small number of observations (counties) and the shape of the distribution of need and services in the state. As we have shown above, Baltimore City's outlier status had an effect on the linear correlation between need and services. Because of the squaring of values inherent in the least squares estimation methodology, there are classic concerns that outliers have disproportionate effects on the regression parameters and associated correlation. To investigate the sensitivity to this issue of the regression analysis results in Figure 17 and Table 6, we estimated a regression analysis in which Baltimore City had been removed (Table 8). The resulting formula based on data from the other twenty-three counties was then applied to Baltimore City' SNI score to assess the impact of the outlier (Pindyk and Rubinfeld 1981). With Baltimore City removed from the estimation analysis, the intercept declined 18% from 479.559 to 394.757 and the slope increased 10% from 35.826 to 39.501. These changes in the position of the regression line made relatively little difference in the size of the estimated gaps for the counties, except Baltimore City and Worcester County. The estimate of Baltimore City's gap of 116 admissions per 100,000 per year (10^{th} largest) increased more than three-fold to 364 admissions per 100,000, which was the fifth biggest gap in the state according to that analysis. The increase would translate to a rise in the estimated additional treatment admissions (public and private) per year from 741 to 2,335. Worcester had the second highest SNI score (55), and its gap increased from 160 to 276 per 100,000 in the sensitivity analysis. These results confirm what many would consider obvious, namely, that any analysis of substance abuse needs and services in Maryland will be impacted by whether or not Baltimore City was included. There is no indication that Baltimore's high SNI and treatment admissions resulted from measurement error.

The sensitivity analysis suggests that a question remains whether even more services may be needed by Baltimore City's and Worcester County's residents. We searched for existing information from other sources (e.g., published studies) to determine whether there was any indication of significant unmet needs in these two jurisdictions. What we located primarily focused on the tripling of treatment services and a significant decline of drug deaths in Baltimore City during the ten years whose end coincided with the end of the present study (e.g., Baltimore City Health Department 2006). With the lack of existing evidence, we believe that conducting further research on the unmet needs for Baltimore City and Worcester County would be prudent. The research should seek to determine whether technical aspects of the regression equation led to an underestimate of the amount of services that should be provided to address Baltimore City's and Worcester County's extreme levels of need. For example, researchers could examine whether there were excessively long waiting lists in those two jurisdictions compared to other counties, whether levels of occupancy in Baltimore City and Worcester County's programs were higher than in other counties, or whether disproportionately large numbers of Baltimore City and Worcester County residents were traveling elsewhere for treatment when compared to residents in the rest of the state. We recommend that the state should consider giving the residents of Baltimore City and Worcester County the benefit of the doubt by allocating the additional admissions while research to resolve this technical issue is being conducted.

Another possible modification of the regression equation that we evaluated was to force the intercept through the origin (the point where X and Y equal zero). The intercept is where the regression line crosses the Y axis. Constraining the regression line to go through the origin assumes that an SNI score of zero (no deaths, arrests or hospital discharges in five years) would on average result in no treatment admissions in a county. As noted by Draper and Smith (1966, p. 13), "This is a very strong assumption which is usually unjustified." In many regression analyses, the intercept has a negative value when such a value is not possible. In such cases, no interpretation of the intercept is necessary or undertaken. In the present case, a zero SNI score is conceivable but it is outside of the range of experience for Maryland. In our national county study, only two very small counties (populations of 118 and 1,500 respectively) out of more than 3,000 counties had SNI scores of zero.

Table 8. Sensitivity Analysis: Comparison of Regression Results With An Analysis Without Baltimore and Without an Intercept

Parameters/ Counties	Treatment Admission Gaps per 100,000 (Observed Minus Predicted)	Regression Analysis Without Baltimore City, With Equation Applied to Baltimore City	Regression Analysis With Intercept Constrained to Origin
Intercept	479.559	394.757	0
Slope	35.826	39.501	48.842
1 Allegany	-550	-586	-497
16 Prince George's	-493	-464	-209
3 Baltimore County	-434	-448	-305
13 Howard	-397	-363	-95
7 Cecil	-259	-296	-228
15 Montgomery County	-254	-209	85
12 Harford	-249	-241	-43
23 Worcester	-160	-276	-391
10 Fredrick	-120	-101	125
24 Baltimore City	-116	-364	-817
2 Anne Arundel	-101	-95	99
6 Carroll	-76	-58	167

Table 8. Sensitivity Analysis: Comparison of Regression Results With An Analysis Without Baltimore and Without an Intercept

Parameters/ Counties	Treatment Admission Gaps per 100,000 (Observed Minus Predicted)	Regression Analysis Without Baltimore City, With Equation Applied to Baltimore City	Regression Analysis With Intercept Constrained to Origin
11 Garrett	-43	-30	181
18 Saint Mary's	-24	-14	191
21 Washington	-18	-14	176
8 Charles	24	48	289
4 Calvert	116	115	292
17 Queen Anne's	172	181	383
20 Talbot	177	139	221
9 Dorchester	180	111	115
5 Caroline	412	409	580
19 Somerset	645	652	848
22 Wicomico	779	769	923
14 Kent	788	771	905

The SNI was designed to focus on relatively severe consequences of substance use: deaths, arrests, and hospital discharges. For example, three Maryland counties had no drug deaths in 2001-2005, but they all had drug treatment admissions. Treatment admissions of clients who are merely family members of substance abusers have been excluded from these analyses, so those admissions are not part of the analysis. One of the three counties with no drug deaths, Kent County, had one of the highest drug treatment admission rates in the state. When the national county SNI was regressed on the 1997 treatment admission rate, the intercept was 484.

Our analysis of survey data from the 2006 National Survey on Drug Use and Health (NSDUH) public use data set found that 1% of the people who lacked a past year drug or alcohol use disorder reported receiving treatment in the past year. They represented 37% of people who obtained substance abuse treatment in the past year. In fact, people who do not have indicators of needing treatment, such as by meeting formal diagnostic criteria for a substance use disorder or by having some serious drug or alcohol consequence, nevertheless sometimes seek and obtain treatment. The rate is low, but we would not expect it to be zero. Consequently, we have concluded on the basis of theoretical as well as limited empirical grounds that the intercept would not go through the origin, but would have a positive value.

When we estimated the regression with the intercept forced to go through the origin, the results on the estimates of treatment gaps were quite different from the other regression models. The number of counties with gaps declined from 15 to six. Counties that no longer had estimated treatment gaps were Montgomery, Fredrick, Anne Arundel, Carroll, Garrett, Saint Mary's, and Washington. The biggest impact was observed in Baltimore City, whose estimated treatment gap increased from 116 to 817 admissions per 100,000. The second largest increase in estimated treatment gap was in Worcester, which went from 276 to 391. The gaps in nearly all of the other counties declined in magnitude. Overall, we do not believe that this model is theoretically justifiable, and its results do not appear to be a balanced model of unmet treatment needs.

APPENDIX D.

Bar Charts of Substance Abuse Arrest, Hospital Discharge, and Mortality Rates

Figure 20. Substance Abuse Arrest Rates, 2001-2005

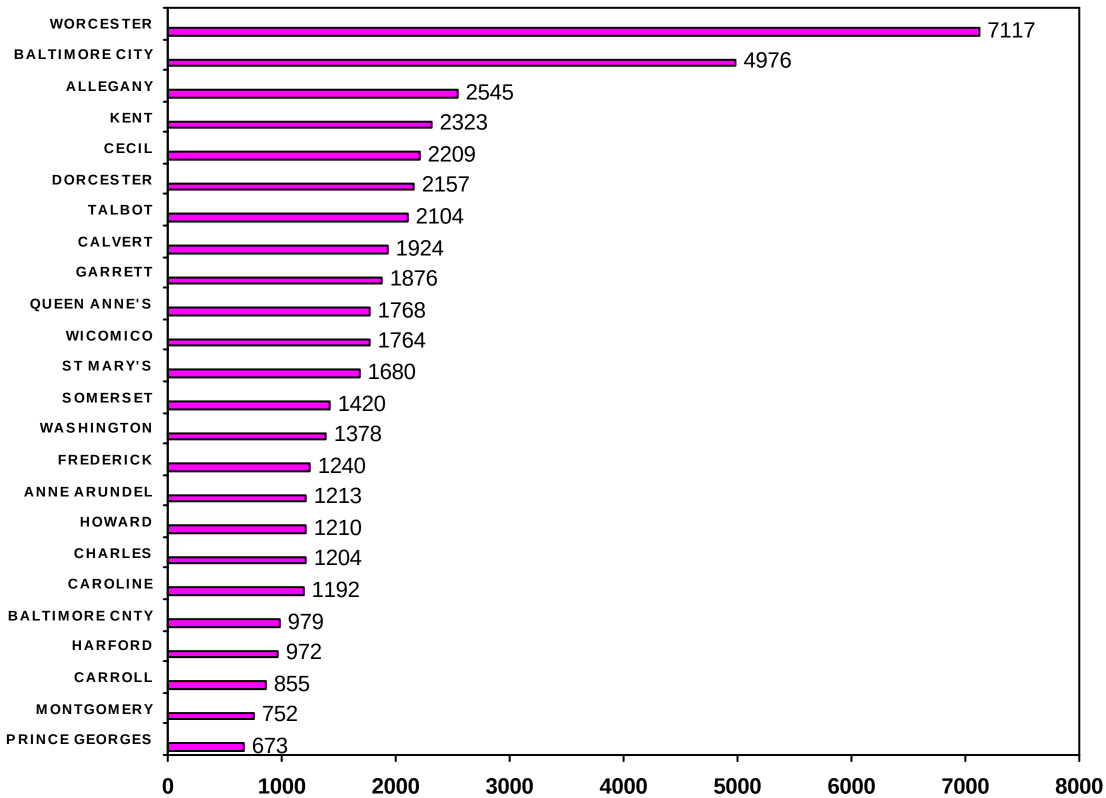


Figure 21. Substance Abuse Mortality Rates, 2001-2005

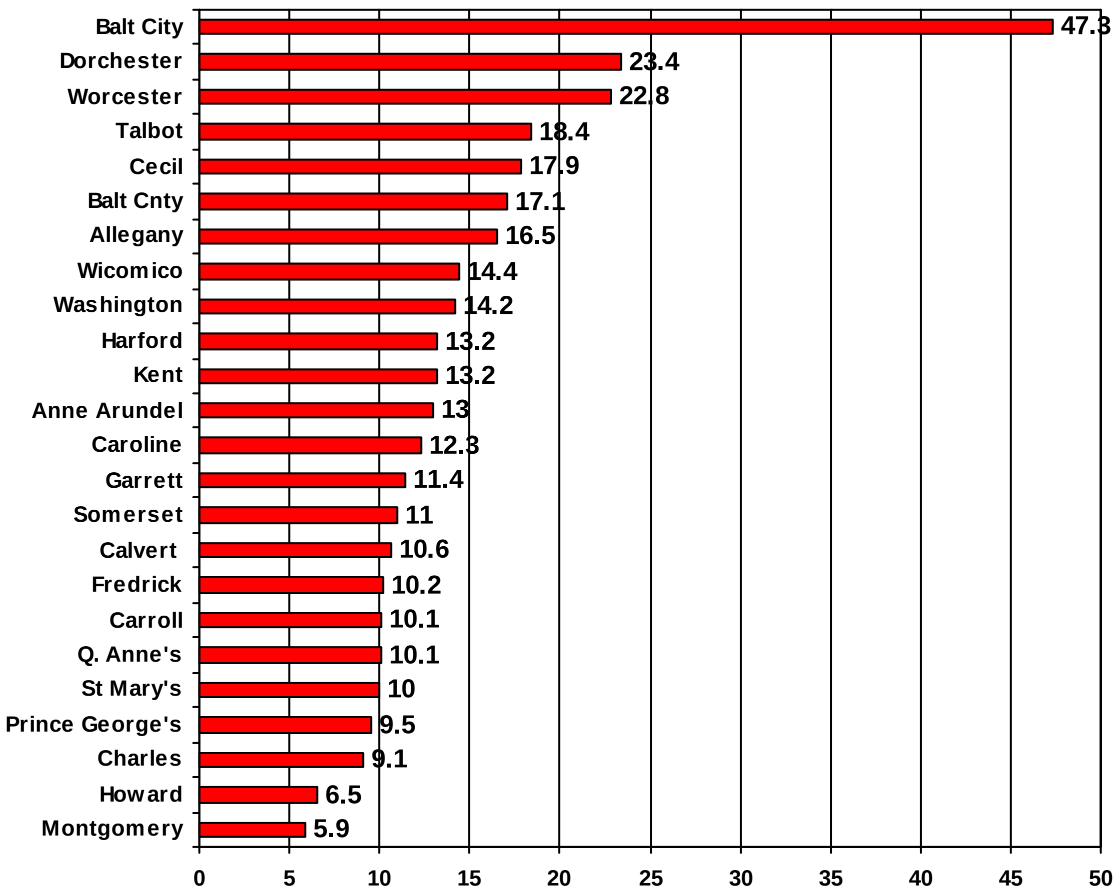
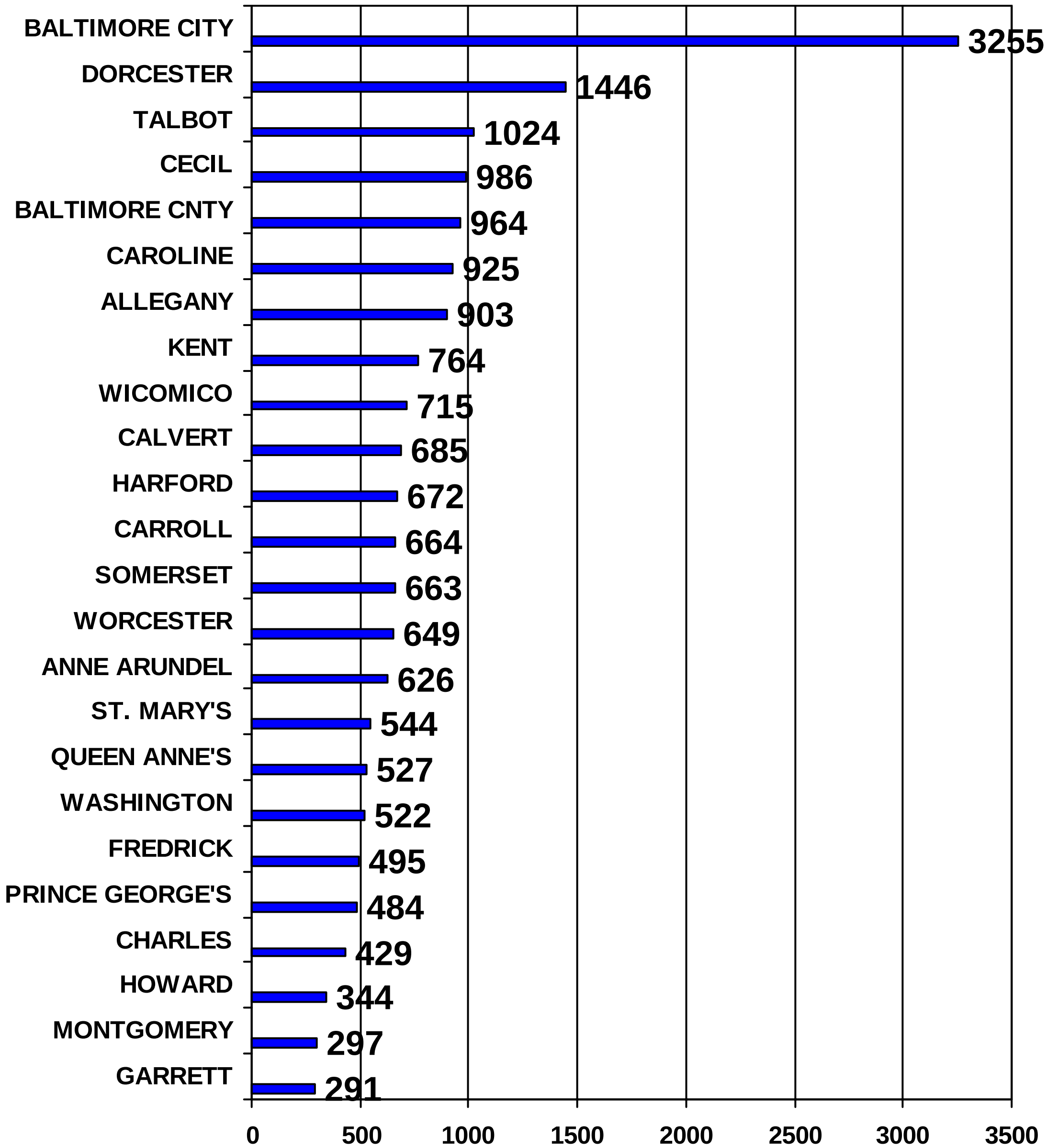


Figure 22. Substance Abuse Hospital Discharge Rates, 2001-2005



APPENDIX E.

Consistency of Need Index Components and Non-Index Drug and Alcohol Indicators

Table 9. Consistency of Drug Need Components and Non-Index Indicators				
	Ranking (of 24, 1=highest)			
Drug Treatment Need Index and Indicators	Baltimore City	Cecil County	Montgomery County	Prince George's County
Maryland Drug Need Index Score Rank (Value)	1 (100)	5.5 (20)	24 (6)	19.5 (9)
Drug Mortality Rate, 2001-2005	1	6	19	13
Drug Arrest Rate, 2001-2005	1	7	24	23
Drug-Related Hospital Discharge Rate, 2001-2005	1	4	23	19

	Ranking (of 24, 1=highest)			
Non-Index Indicators of Drug Treatment Need	Baltimore City	Cecil County	Montgomery County	Prince George's County
IDU-AIDS Prevalence Rate, 2001-2005	1	9	11	2
Drug Treatment Admissions Rate, 2001-2005	1	8	24	22
Hospital Drug Treatment Rate, 2001-2005	1	21	5	11
Indicators Commonly Correlated With High Rates of Drug Problems				
Syphilis Rate, 2004	1	20.5	12.5	3
Robbery Arrest Rate, 2001-2005	1	15	11	7
Prostitution Arrest Rate, 2001-2005	1	17	13	11
Percent Nonwhite, 2000	2	22	4	1
Low Median Household Income, 2001-2005 Average (1=low)	2	12	23	15
Percent of All Individuals in Poverty, 2004	1	14	19.5	11

Table 10. Consistency of Alcohol Need Index Indicators and Non-Index Alcohol Indicators				
	Ranking (of 24, 1=highest)			
Alcohol Treatment Need Index and Component Indicators	Baltimore City	Cecil County	Montgomery County	Prince George's County
Maryland Alcohol Need Index (Value)	1 (69)	6 (39)	24 (13)	23 (16)
Alcohol Mortality Rate, 2001-2005	1	6	23	22
Alcohol-Related Arrests (includes DUI, Liquor Law, and or Disorderly Conduct) Rate, 2001-2005	24	3	20	23
DUI Arrest Rate. 2001-2005	24	3	20	23
Liquor Law Violation Arrest Rate, 2001-2005	20	13	22	9
Disorderly Conduct Arrest Rate, 2001-2005	7	2	24	21
Alcohol-Related Hospital Discharge Rate, 2001-2005	1	5	24	21

	Ranking (of 24, 1=highest)			
Non-Index Indicators of Alcohol Treatment Need	Baltimore City	Cecil County	Montgomery County	Prince George's County
Alcohol Treatment Admissions Rate, 2001-2005	17	14	22	24
Hospital Alcohol Treatment Rate, 2001-2005	1	20	8	17
% Binge Drinking, 18+, BRFSS 2001-2005	18	11	20	22
% Heavy Drinking, 18+, BRFSS 2001-2005	11	22	19	23
% Binge Drinking, 12^{th} Graders, 2000-2005	24	10	22	23.5
Liquor License Rate, 2001-2005	7	13	19	24
Per Capita Consumption of Spirits, Beer, and Wine (gallons), 2001-2005	12	2	24	22

Alcohol and/or Drug Impaired Driver in Fatal Crash Rate, 2001-2005	23	5	24	15
Alcohol and/or Drug Impaired Driver in Crash Rate, 2001-2005	18	5	24	20

Table 11. Standard Scores (Z Scores) for Substance Need Indicators, by County

	Substance Indicator Z Scores			Substance Need Index: (Sum of Z Scores)	
Jurisdiction	Mortality	Hospital Discharge	Arrests	Unscaled SNI	Scaled SNI
Baltimore City	3.9583	4.1926	2.1756	10.3265	91
Worcester County	1.0012	-0.2341	3.6887	4.4559	55
Dorchester County	1.0722	1.1197	0.1836	2.3756	42
Talbot County	0.4743	0.4032	0.1463	1.0239	34
Allegany County	0.2444	0.1976	0.4578	0.8997	33
Cecil County	0.4071	0.3395	0.2202	0.9668	33
Kent County	-0.1541	-0.0386	0.3007	0.1080	28
Baltimore County	0.3090	0.3019	-0.6487	-0.0378	27
Wicomico County	-0.0100	-0.1206	-0.0941	-0.2247	26
Caroline County	-0.2609	0.2355	-0.4984	-0.5238	24
Calvert County	-0.4736	-0.1730	0.0192	-0.6275	23
Washington County	-0.0404	-0.4484	-0.3668	-0.8557	22
Anne Arundel County	-0.1789	-0.2724	-0.4838	-0.9351	21
Somerset County	-0.4244	-0.2101	-0.3370	-0.9716	21
Harford County	-0.1514	-0.1945	-0.6537	-0.9996	21
Queen Anne's County	-0.5363	-0.4400	-0.0910	-1.0674	21
St. Mary's County	-0.5469	-0.4111	-0.1536	-1.1116	20

Garrett County	-0.3786	-0.8419	-0.0148	-1.2353	20
Carroll County	-0.5308	-0.2071	-0.7366	-1.4745	18
Frederick County	-0.5227	-0.4957	-0.4647	-1.4830	18
Charles County	-0.6499	-0.6062	-0.4896	-1.7457	16
Prince George's County	-0.6050	-0.5137	-0.8650	-1.9837	15
Howard County	-0.9693	-0.7511	-0.4853	-2.2056	14
Montgomery County	-1.0333	-0.8316	-0.8090	-2.6739	11

REFERENCES

Adamsson, N.B. (2003) Medical treatment: Barriers to implementation of Bupernorphine in opioid addiction treatment. *Journal of Addictive Disorders. www.breining.edu.*

American Psychiatric Association (1980) *Diagnostic and Statistical Manual of Mental Disorders (Third Edition): DSM-III*, edn. Washington, DC: American Psychiatric Association.

American Psychiatric Association (1994) *Diagnostic and Statistical Manual of Mental Disorders (Fourth Edition): DSM-IV*, Washington, DC: American Psychiatric Association.

Aoun, S., Pennebaker, D. and Wood, C. (2004) Assessing population need for mental health care: a review of approaches and predictors. *Ment Health Serv Res* **6**, 33-46.

Baltimore City Health Department (2006) Drug Treatment in Baltimore: 2005. Baltimore, MD: Baltimore Substance Abuse Systems.

Beardsley, K., Wish, E., Fitzelle, D., O'Grady, K. and Arria, A. (2003) Distance traveled to outpatient drug treatment and client retention. *Journal of Substance Abuse Treatment* **25**, 279-285.

Beenstock, M. (1995) An indicator model of drug use in Israel. *Addiction* **90**, 425-433.

Bentler, P.M. (1978) The interdependence of theory, methodology, and empirical data: Causal modeling as an approach to construct validation. In: Kandel, D.B., (Ed.) *Longitudinal Research on Drug Use: Empirical Findings and Methodological Issues*, pp. 267-302. Washington, DC: Hemisphere.

Beshai, N. (1984) Assessing needs of alcohol-related services: a social indicators approach. *American Journal of Drug and Alcohol Abuse* **10**, 417-427.

Borges, N.J. and Hansen, S.L. (1993) Correlation between college students' driving offenses and their risks for alcohol problems. *Journal of American College Health* **42**, 79-81.

Brands, B., Blake, J. and Marsh, D. (2002) Changing patient characteristics with increased methadone maintenance availability. *Drug and Alcohol Dependence* **66**, 11-20.

Breer, P., McAuliffe, W. E., and Levine, E. B. (1996). Statewide substance abuse prevention planning. *Evaluation Review* **20**, 596-618.

Campbell, D.T. and Fiske, D.W. (1959) Convergent and discriminant validation by the multitrait-multimethod matrix. *Psychological Bulletin* **56**, 833-853.

Center for Substance Abuse Treatment (1992) *Technical Assistance Publication Series Number 3: Need, Demand, and Problem Assessment for Substance Abuse Services*, Rockville, MD: Center for Substance Abuse Treatment (CSAT).

Centers for Disease Control and Prevention (CDC) (1994) *Reported Tuberculosis in the United States, 1993*, Atlanta, GA: CDC, Division of Tuberculosis Elimination.

Chalmers, D., Olenick, N.L. and Stein, W. (1993) Dispositional traits as risk in problem drinking. *Journal of Substance Abuse* **5**, 401-410.

Chong, J. (1998) Crime indicators for alcohol and drug abuse. *Criminal Justice and Behavior* **25**, 283-305.

Cleary, P.D. (1979) A standardized estimator of the prevalence of alcoholism based on mortality data. *Journal of Studies on Alcohol* **40**, 408-418.

Cohen, J. and Cohen, P. (1975) *Applied Multiple Regression/Correlation Analysis for the Behavioral Sciences*, Hillsdale, NJ: Lawrence Erlbaum Associates.

Community Epidemiology Work Group (CEWG) (1999) *Epidemiologic Trends in Drug Abuse*, Washington, DC: U.S. Department of Health and Human Services.

Craddock, A., Collins, J.J. and Timrots, A. (1994) *Fact Sheet: Drug-Related Crime*, Rockville, MD: Office of National Drug Control Policy Drugs and Crime Clearinghouse.

Cronbach, Lee J. (1951). Coefficient alpha and the internal structure of tests. *Psychometrika.* **16**, 297-334.

Cronbach, L.J. and Meehl, P.E. (1967) Construct validity in psychological tests. In: Mehrens, W.A. and Ebel, R.L., (Eds.) *Principles of Educational and Psychological Measurement*, pp. 243-270. Chicago, IL: Rand McNally & Co.

DeFleur, L.B. (1975) Biasing influences on drug arrest records: implications for deviance research. *American Sociological Review* **40**, 88-103.

DeWit, D.J. and Rush, B.R. (1996) assessing the need for substance abuse services: a critical review of needs assessment models. *Evaluation and Program Planning* **19**, 41-64.

Deykin, E.Y., Minugh, P.A., Adams, C., McAuliffe, W.E., LaBrie, R.A. and McKinney, D. (1995) *State Substance Abuse Treatment Demand and Needs Assessment Studies of Alcohol and Other Drugs*, Cambridge, MA: National Technical Center for Substance Abuse Needs Assessment.

Dickey, B., Dembling, B., Azeni, H. and Normand, S.L. (2004) Externally caused deaths for adults with substance use and mental disorders. *J Behav Health Serv Res* **31**, 75-85.

Draper, N.R. and Smith, H. (1966) *Applied Regression Analysis*, New York: John Wiley & Sons, Inc.

Everline, Theresa (2000) Treatment trials. *Orlando Weekly*.

Ericson, Edward (2006) Baltimore's drug treatment system is a model—But no one knows how well it works. Downloaded from www.citypaper.com/news/story.asp?id=11935.

Fazel, S., Bains, P. and Doll, H. (2006) Substance abuse and dependence in prisoners: a systematic review. *Addiction* **101**, 181-91.

Federal Bureau of Investigation (FBI). (1992). *Uniform Crime Reporting Handbook, National Incident-Based Reporting System Edition*. Washington, D.C.: U.S. Department of Justice.

Fingerhut, L.A. (2006) Increases in methadone-related deaths: 1999-2004. *National Center for Health Statistics.*

Fiorentine, R. (1994) Assessing drug and alcohol treatment needs of general and special populations: conceptual, empirical, and inferential issues. *Journal of Drug Issues* **24**, 445-462.

Frank, B. (1985) Telephone Surveying for Drug Abuse: methodological issues and an application. In: Rouse, B.A., Kozel, N.J. and Richards, L.G., (Eds.) *Self-Report Methods of Estimating Drug Use: Meeting Current Challenges to Validity*, pp. 71-82. Rockville, MD: National Institute on Drug Abuse.

Frank, B. and Lipton, D.S. (1984) Epidemiology of the current heroin crisis. In: Serban, G., (Ed.) *The Social and Medical Aspects of Drug Abuse*, pp. 93-99. New York, NY: Spectrum Publications, Inc.

Ford, W.E. and Schmittdiel, C.J. (1983) Predicting alcoholism services needs from a national treatment utilization survey. *International Journal of the Addictions* **18**, 1073-1084.

Furst, C.J. and Beckman, L.J. (1981) Alcohol-related mortality and alcohol consumption statistics: stability of estimates for small areas. *Journal of Studies on Alcohol* **42**, 57-63.

Gfroerer, J.C., Wright, D. and Kopstein, A.N. (1997) Prevalence of youth substance use: the impact of methodological differences between two national surveys. *Drug and Alcohol Dependence* **47**, 19-30.

Gregoire, T.K. (2002) The validity of a social indicator approach to substance misuse needs assessment. *Substance Use & Misuse* **37**, 357-380.

Gruenewald, P.J. and Ponicki, W.R. (1995) The relationship of alcohol sales to cirrhosis morality. *Journal of Studies of Alcohol* **56**, 635-641.

Hannon, L. and Cuddy, M.M. (2006) Neighborhood ecology and drug dependence mortality: an analysis of New York City census tracts. *Am J Drug Alcohol Abuse* **32**, 453-63.

Harman, H.H. (1967) *Modern Factor Analysis*, Second Edition Revised. Chicago: The University of Chicago Press.

Helderman, R.S. (2008) Gaps Seen in Md. Drug Treatment. *Washington Post. www.washingonpost.com.* October 19.

Hembree, C., Galea, S., Ahern, J., Tracy, M., Markham Piper, T., Miller, J., Vlahov, D. and Tardiff, K.J. (2005) The urban built environment and overdose mortality in New York City neighborhoods. *Health Place* **11**, 147-56.

Herman-Stahl, M., Wiesen, C.A., Flewelling, R.L., Weimer, B.J., Bray, R.M. and Valley Rachal, J. (2001) Using social indicators to estimate county-level substance use intervention and treatment needs. *Substance Use & Misuse* **36**, 501-522.

Hoffmann, N.G., Halikas, J.A., Mee-Lee, D. and Weedman, R.D. (1991) *Patient Placement Criteria for the Treatment of Psychoactive Substance Use Disorders*, Washington, DC: American Society of Addiction Medicine.

Ingram, J.J. (1988) Alcoholism treatment demand estimation. *Health Marketing Quarterly* **6**, 195-205.

Jonas, H., Dietze, P., Rumbold, G., Hanlin, K., Cvetkovski, S. and Laslett, A.M. (1999) Associations between alcohol related hospital admissions and alcohol consumption in Victoria: influence of sociodemographic factors. *Australian New Zealand Journal of Public Health* **23**, 272-279.

Joska, J. and Flisher, A.J. (2005) The assessment of need for mental health services. *Soc Psychiatry Psychiatr Epidemiol* **40**, 529-39.

Kennedy, B.P., Isaac, N.E. and Graham, J.D. (1996) The role of heavy drinking in the risk of traffic fatalities. *Risk Analysis* **16**, 565-569.

Lapham, S.C., Smith, E., Baca, J.C., Chang, L., Skipper, B.J., Baum, G., Hunt, W.C., Ball, J., Kissin, W. and Garfield, T. (2001) Prevalence of psychiatric disorders among persons convicted of driving while impaired. *Archives of General Psychiatry* **58**, 943-949.

Lesage, A.D., Clerc, D., Uribe, I., Cournoyer, J., Fabian, J., Tourjman, V., Van Haaster, I. and Chang, C.H. (1996) Estimating local-area needs for psychiatric care: a case study. *Br J Psychiatry* **169**, 49-57.

Maddock, J.M., Daley, D.C. and Moss, H.B. (1988) A practical approach to needs assessment for chemical dependency programs. *Journal of Substance Abuse Treatment* **5**, 105-111.

Malarkey, Jaime (2006) Lawyers wrap up methadone clinic case. Downloaded from www.examiner.com.

Mancino, M., Cunningham, M.R., Davidson, P. and Fulton, R.L. (1996) Identification of the motor vehicle accident victim who abuses alcohol: an opportunity to reduce trauma. *Journal of Studies on Alcohol* **57**, 652-658.

Maryland State Office of Rural Health (2007) Maryland Rural Areas 2007. Maryland Department of Health and Mental Hygiene.

Maryland Alcohol and Drug Abuse Administration (2008) Outlook and Outcomes: Fiscal Year 2007 Annual Resport. Catonsville, MD: Maryland Alcohol and Drug Abuse Administration, Department of Health and Mental Hygiene.

McAuliffe, W.E. (2004) Measuring treatment needs: a reply to Gfroerer, Epstein, and Wright. *Addiction* **99**, 1219-20.

McAuliffe, W.E. (2005) *Massachusetts Social Indicator Study: Statewide Report*, Boston, MA: Massachusetts Department of Public Health.

McAuliffe, W.E., Breer, P., Ahmadifar, N.W. and Spino, C. (1991) Assessment of drug abuser treatment needs in rhode island. *American Journal of Public Health*   **81**, 365-371.

McAuliffe, W.E. and Dunn, R.P. (2004) Substance abuse treatment needs and access in the united states: interstate variations. *Addiction* **99**, 999-1014.

McAuliffe, W.E., Dunn, R. and Zhang, C.H. (2001d) *An Integrated Substance Abuse Treatment Needs Assessment for Montana*, Department of Public Health and Human Services, Addictive and Mental Disorders Division.

McAuliffe, W.E., Dunn, R. and Zhang, C.H. (2002b) *A Substance Abuse Indicator Chartbook for North Dakota*, North Dakota Department of Human Services, Division of Mental Health and Substance Abuse Services.

McAuliffe, W.E., Dunn, R.P. and Zhang, C. (2002c) *Study of Rhode Island's Substance Abuse Treatment Service Needs* , Cambridge, MA: North Charles Research and Planning Group .

McAuliffe, W.E., Haddad, S., LaBrie, R., Woodworth, R., Mellitt, J. and Stablein, T. (2001c) *A Drug and Alcohol Abuse Indicator Chart Book for Alaska's Boroughs and Census Areas*, Cambridge, MA: North Charles Research and Planning Group.

McAuliffe, W.E., LaBrie, R., Haddad, S., Sevigny, E., Ronis, S., Woodworth, R., Williamson, S., Scherer-Gonzales, J. and Leary, J. (2000) *The Substance Abuse Treatment Needs of Rhode Island's Prisoner and Training School Populations*, Cambridge, MA: North Charles, Inc.

McAuliffe, W.E., LaBrie, R.A., Lomuto, N., Betjemann, R. and Fournier, E.A. (1999) Measuring interstate variations in drug problems. *Drug and Alcohol Dependence* **53**, 125-145.

McAuliffe, W.E., LaBrie, R.A., Lomuto, N.A., Pollock, N.E., Betjemann, R. and Fournier, E. (2000) Measuring interstate variations in problems related to alcohol use disorders. In: Wilson, R.A. and Dufour, M.C., (Eds.) *The Epidemiology of Alcohol Problems in Small Geographic Areas*, First Edition. pp. 213-244. Bethesda, MD: National Institute on Alcohol Abuse and Alcoholism.

McAuliffe, W.E., LaBrie, R., Mellitt, J., Stablein, T. and Woodworth, R. (2001b) *A Drug and Alcohol Abuse Indicator Chart Book for North Dakota*, Cambridge, MA: North Charles Research and Planning Group.

McAuliffe, W.E., LaBrie, R., Sevigny, E., Woodworth, R., Mellitt, J. and Stablein, T. (2001)

Substance Abuse Treatment Needs of Alaska's Newly Incarcerated Prisioner Population Prior to Incarceration: Final Report, Cambridge, MA: North Charles Research and Planning.

McAuliffe, W.E., LaBrie, R., Woodworth, R., Nielsen, K., Ronis, S., Sevigny, E. and Robinson, T. (1998) *A Substance Abuse Indicator Chart Book for Rhode Island's Cities and Towns: Central Falls*, Cambridge, MA: National Technical Center for Substance Abuse Needs Assessment, North Charles Research and Planning Group.

McAuliffe, W.E., LaBrie, R., Woodworth, R., Zhang, C. and Dunn, R.P. (2003) State substance abuse treatment gaps. *American Journal on Addictions* **12**, 101-121.

McAuliffe, W.E., Mellitt, J., LaBrie, R., Woodworth, R., Stablein, T. and Haddad, S. (2001a) *A Drug and Alcohol Abuse Indicator Chart Book for Colorado*, Cambridge, MA: North Charles Research and Planning Group.

McAuliffe, W.E., Santangelo, S.L., Magnuson, E., Ginsberg, J., McAuliffe, D. and Sobol, A. (1986) *Assessment of the Need for Drug Treatment Services in Massachusetts*, Cambridge, MA: Division of Drug Rehabilitation, Massachusetts Department of Public Health.

McAuliffe, W.E., Woodworth, R., Zhang, C. and Dunn, R.P. (2002a) Identifying substance abuse treatment gaps in substate areas. *Journal of Substance Abuse Treatment* **23**, 199-208.

McBride, D.C. and McCoy, C.B. (1985) *The Methodologies of Performing Needs Assessments of Drug Use*, Washington, D.C. : Forecasting Branch, National Institute on Drug Abuse.

McClelland, G.M., Elkington, K.S., Teplin, L.A. and Abram, K.M. (2004) Multiple substance use disorders in juvenile detainees. *J Am Acad Child Adolesc Psychiatry* **43**, 1215-24.

Mee-Lee, D., Shulman, G.D., Fishman, M., Gastfriend, D.R. and Griffith, J.H. (2001) *ASAM Patient Placement Criteria for the Treatment of Substance-Related Disorders*, 2nd Edition, Revised. Chevy Chase, MD: American Society of Addiction Medicine.

Midanik, L.T., Greenfield, T.K. and Bond, J. (2007) Addiction sciences and its psychometrics: the measurement of alcohol-related problems. *Addiction* **102**, 1701-10.

Narrow, W.E., Rae, D.S., Robins, L.N. and Regier, D.A. (2002) Revised prevalence estimates of mental disorders in the united states: using a clinical significance criterion to reconcile 2 surveys' estimates. *Archives of General Psychiatry* **59**, 115-123.

Nunnally, J.C. and Bernstein, I.H. (1994) *Psychometric Theory*, Third Edition. New York

McGraw-Hill.

Office of Applied Studies (2006) *Substate estimates from 2002-2004 National Surveys on Drug Use and Health*, Rockville, MD: Substance Abuse and Mental Health Services Administration.

Office of Applied Studies (2007) Substate Area estimates of substance use disorders for Maryland, 2005 and 2006. Provided to the study as a result of a special analysis of data from the National Survey of Drug Use and Health. Rockville, MD: Substance Abuse and Mental Health Services Administration.

Person, P.H. Jr., Retka, R.L. and Woodward, J.A. (1976) *Toward a Heroin Problem Index--An Analytical Model for Drug Abuse Indicators (Technical Paper)*, Rockville, MD: National Institute on Drug Abuse.

Petronis, K.R., Wish, E.D. and Center for Substance Abuse Research (1996) *Substance Abuse and Need for Treatment in Maryland: Results of a Telephone Survey Conducted as Part of the Maryland State Demand and Needs Assessment Studies*, College Park, Maryland: University of Maryland.

Pindyk, R.S. and Rubinfeld, D.L. (1981) *Econometric Models and Economic Forecasts*, 2nd edn. New York: McGraw-Hill Book Company.

Regier, D.A., Myers, J.K., Kramer, M., Robins, L.N., Blazer, D.G., Hough, R.L., Eaton, W.W. and Locke, B.Z. (1984) The NIMH Epidemiologic Catchment Area program: historical context, major objectives, and study population characteristics. *Archives of General Psychiatry* **41**, 934-941.

Regier, D.A., Narrow, W.E., Rupp, A., Rae, D.S. and Kaelber, C.T. (2000) The epidemiology of mental disorder treatment need: community estimates of "medical necessity". In: Andrews, G. and Henderson, S., (Eds.) *Unmet Needs in Psychiatry*, pp. 41-58. New York, NY: Cambridge University Press.

Reuter, P., Hsu, M., Petronis, K. and Wish, E. (1998) *Estimating the Need for Substance Abuse Treatment in Maryland*, College Park, MD: Maryland Alcohol and Drug Abuse Administration.

Rhodes, W.M. (1993) Synthetic estimation applied to the prevalence of drug use. *Journal of Drug Issues* **23**, 297-321.

Richards, L.G. (1985) *Drug Abuse Epidemiologic and Needs Assessment Approaches by*

States and Small Areas A State of the Art Review, Rockville, MD: National Institute on Drug Abuse.

Robins, L.N., Helzer, J.E., Croughan, J.L. and Ratcliff, K.S. (1981) The NIMH Diagnostic Interview Schedule: its history, characteristics and validity. *Archives of General Psychiatry* **38**, 381-389.

Roizen, R., Kerr, W.C. and Fillmore, K.M. (1999) Cirrhosis mortality and per capita consumption of distilled spirits, United States, 1949-94: trend analysis. *British Medical Journal (BMJ)* **319**, 666-670.

Rosenfeld, R. and Decker, S. (1999) Are arrest statistics a valid measure of illicit drug use? The relationship between criminal justice and public health indicators of cocaine, heroin and marijuana use. *Justice Quarterly* **16**, 685-699.

Schmitt, S., Phibbs, C.S. and Piette, J.D. (2003) The influence of distance on utilization of outpatient mental health aftercare following substance abuse treatment. *Addictive Behaviors* **28**, 1183.

Shapiro, S., Skinner, E.A., Kramer, M., Steinwachs, D.M. and Regier, D.A. (1985) Measuring need for mental health services in a general population. *Medical Care* **23**, 1033-1043.

Scherpenzeel, A.C. and Saris, W.E. (1997) The validity and reliability of survey questions: a meta-analysis of MTMM studies. *Sociological Methods and Research* **25**, 341-383.

Simeone, R.S., Frank, B. and Aryan, Z. (1993) Needs assessment in substance misuse: a comparison of approaches and case study. *International Journal of the Addictions* **28**, 767-792.

Spence, R.T., Fredlund, E.V. and Kavinsky, J. (1989) *1988 Texas Survey of Substance Use Among Adults: Executive Summary*, Austin, TX: Texas Commission on Alcohol and Drug Abuse.

Stinson, Frederick S. and Thomas M. Nephew. (1996). *State Trends in Alcohol-Related Mortality, 1997-1992.* Bethesda, MD: National Institute on Drug Abuse.

Stinson, F.S., Proudfit, A.H., Harford, T.C., Dufour, M.C. and Noble, J.A. (1994) *County Alcohol Problem Indicators 1986-1990*, Fourth Edition. Rockville, MD: National Institute on Alcohol Abuse and Alcoholism.

Vingilis, E. (1983) Drinking drivers and alcoholics: are they from the same population? In:

Smart, R.G., Glaser, F.B., Israel, Y., Kalant, H., Popham, R.E. and Schmidt, W., (Eds.) *Research Advances in Alcohol and Drug Problems*, pp. 299-342. New York: Plenum Press.

Warheit, G.J., Bell, R.A. and Schwab, J.J. (1977) *Needs Assessment Approaches: Concepts and Methods*, Washington, D.C.: Department of Health, Education, and Welfare.

Wilson, R.A. and Hearne, B.E. (1986) An assessment of the state of the art in drug abuse and alcoholism treatment needs estimation methods. In: Einstein, S., (Ed.) *Treating the Drug User: Selected Planning Models, Issues, Parameters, and Programs*, pp. 186-221. Danbury, CT: Sandoz Publications.

Wilson, R.A. and McAuliffe, W.E. (2000) Synthetic estimates of the prevalence of DSM-III-R alcohol abuse and dependence: issues of validity and methodology. In: Wilson, R.A. and Dufour, M.C., (Eds.) *The Epidemiology of Alcohol Problems in Small Geographic Areas*. pp. 17-36. Bethesda, MD: National Institute on Alcohol Abuse and Alcoholism.

Woodward, J.A., Retka, R.L. and Ng, L. (1984) Construct validity of heroin abuse estimators. *International Journal of the Addictions* **19**, 98-117.

Yacoubian, G.S. (2003) Measuring alcohol and drug dependence with New York City ADAM data. *Journal of Substance Abuse Treatment* **24**, 341-345.

Yu, J. and Williford, W.R. (1993) Problem drinking and high-risk drinking: an analysis of official and self-reported drinking-driving in New York State. *Addiction* **88**, 219-228.

Zarkin, G.A., Galinis, D.N., French, M.T., Fountain, D.L., Ingram, P.W. and Guyett, J.A. (1995) Financing strategies for drug abuse treatment programs. *Journal of Substance Abuse Treatment* **12**, 385-399.