

# ADAM: Statistical Issues Related to Prevalence Estimates and Trends

---

William Rhodes

The Arrestee Drug Abuse Monitoring (ADAM) program is (A) a probability-based survey of (B) individuals<sup>1</sup> shortly after they were arrested and booked (C) during a purposively selected two-week period (D) within purposively selected counties throughout the United States. ADAM questions arrestees about drug use and related behaviors and obtains a bioassay used to test for recent drug use. ADAM data are used to estimate (1) prevalence and (2) trends in populations of interest. This briefing summarizes ADAM's sampling and estimation methodology. It also discusses some current and potential uses for ADAM data.

## What Can ADAM Estimate?

From the above definition (D), ADAM produces local area estimates because the survey is done in purposively selected counties. This is not a limitation to the methodology because ADAM could randomly sample from an expanded number of counties leading to national probability-based estimates. In practice it would be difficult to sample in small counties because of costs and there may be an appreciable refusal rate in large counties because some sheriffs will deny admission to booking facilities.

From (C), ADAM samples from two-week periods. In the original version of ADAM (2000-2003), the sample was repeated quarterly, and in the current version (2007-), the sampling is biannual. The convention has been to treat the two-week period as if it had been selected randomly. Current estimation methodology annualizes (to account for possible yearly cycles in drug use) but does not account for sampling variation from week-to-week. In practice the days could be randomly selected, but this would be expensive and sheriffs may preclude interviewing during specific periods.

From (B), ADAM interviews individuals who are *booked*. Many suspects are arrested but not booked, and many are booked but not arrested, so the term *Arrestee* Drug Abuse Monitoring is potentially misleading. There is an advantage to surveying those who were recently booked, as a bioassay is confirmatory of recent drug use, and early identification of study subjects is more inclusive and less selective than a survey of suspects/offenders selected after the sieve of criminal justice processing. A disadvantage is that sampling and interviewing in booking facilities raises logistical problems.

From (A), ADAM is a random sample of arrestees booked within a county. The sample has been designed to minimize standard errors. It leads to probability-based estimates.

---

<sup>1</sup> ADAM is a sample of bookings rather than individuals. We assume saying that this is a *sample of individuals* causes no confusion.

## Sampling, Weighting and Estimation

This section discusses ADAM's sampling, weighting and estimation procedures. This discussion is short and intended to raise issues that might be discussed at greater length.

### Sampling

Where necessary, ADAM samples booking facilities within a county. For many counties, there is a single booking facility, so sampling is unnecessary. In many other counties there are just a few booking facilities, so a stratified sample is practical. In some counties, there are many booking facilities, and ADAM is designed to use a stratified cluster sample. In practice, the stratified cluster sample was never fully implemented. It is difficult logistically when booking facilities are very small; costs are high when there are few bookings per interviewer; and with exceptions (i.e. Los Angeles) selection bias is likely small because the omitted booking facilities account for a small proportion of bookings.

Within each booking facility, interviewers work an eight-hour day that does not vary from day-to-day. More rigorous sampling plans (such as randomly selecting the eight-hour period) were rejected as impractical. Given the fixed eight-hour period, interviewers sample from the stock of offenders who were booked during the previous sixteen hour period (that is, between interviewer work shifts) and interviewers sample from a flow of offenders booked when interviewers are stationed at the booking facility. Sampling is proportional to size, and the sample is roughly balanced so that sampling probabilities fall within a narrow range.

The above describes an ideal. Given the nature of booking processes, arrestees are often unavailable for an interview, and of course some refuse to be interviewed. ADAM replaces arrestees who are unavailable or who refuse with nearest neighbors in booking time. It is sometimes necessary to modify the sampling design to sample at central booking facilities, which are jails that serve as collection points for suspects booked into local facilities and then transferred to the central facility for processing. Almost every ADAM sites requires special design considerations.

### Weighting

Several weeks after the interviews have been completed, sheriffs provided a census of booking records. ADAM matches the interviews with the booking records providing a basis for poststratification.

The current version of ADAM uses the matched interviews/census data to estimate propensity scores. Propensity score estimation accounts for the major factors that explain variations in sampling probabilities: type of charge, resources available for interviewing relative to the size of the stock and flow, and so on. The inverse of the estimated propensity scores are treated as weights.

### Comment on Weighting

The prevalence of drug use varies with factors that might affect sampling probabilities, including the charge. Therefore a convenience sample leads to biased estimates of drug use. Probability-based sampling/estimation distinguishes ADAM from its predecessor: the Drug Use Forecasting (DUF) survey.

Some have noted that ADAM data lead to similar estimates whether the data are weighted or not weighted. The observation risks confusing an issue: Weighting does not make much difference because the ADAM sample is balanced. That is, given the sampling design, sampling probabilities and hence weights vary modestly. This is why weighted and not weighted estimates are so much alike.

However, this does not mean that sampling is irrelevant. Indeed, this assertion is demonstrably wrong because (1) offenders with serious charges are more likely to be available for interviewing, and (2) drug use varies with offense charge. A convenience sample would produce biased estimates. A *good* sampling design matters by providing a balanced sample.

## Estimation

Simple estimation uses weights. For example, an analyst can estimate the proportion of the booking population who tested positive for cocaine. This would be a simple problem except that many study subjects either cannot provide a urine specimen or they refuse. ADAM uses imputation procedures based on Bayesian logic. At the core of this logic, almost all the respondents answer the question about recent drug use. Assuming that drug test results are missing at random conditional on reports of recent drug use, ADAM imputes drug test results and adjusts standard errors accordingly.

Trend estimation is more difficult. There are two problems. The first is that drug use behavior appears to follow yearly cycles in some counties. This is troublesome because the early ADAM data (2000-2003) are from four quarters per year while the later ADAM data (2007 -) are from two quarters per year. The second problem is that arrest, booking and processing practices change over time.<sup>2</sup> This is troublesome because trends in drug use get confounded with trends in arrest, booking and processing practices. ADAM estimates regressions where test results are conditioned on charge, quarter and continuous time. Trend estimates hold charge and quarter constant.

ADAM reports refer to this process of conditioning as *annualization*, although from the above discussion the adjustments account for more than annual cycles. Annualization affects both prevalence estimates and trends. See the annual report for details. Estimation is further complicated by ONDCP instructions to fix past estimates when new estimates are reported. See the methodology report for an explanation.

---

<sup>2</sup> Arrest practices sometimes change over time. An illustration is Giuliani's decision to have New York police arrest people for public order violations. Pretrial release practices change over time. An illustration is police gaining the authority to cite suspects without booking them. Consequently the population surveyed by ADAM changes over time. This is of little consequence if the objective is literally to estimate prevalence and trends in drug use among arrestees, but it is important if the objective is to distinguish drug use per se from changes in administrative procedures.

## Inferences from ADAM Data

Since 2007, ADAM has provided prevalence estimates and annualized yearly trends for drug use and other behaviors for the counties included in the ADAM program. See the annual report for details.

## Generalizing ADAM to Broader Populations

Rhodes, Kling and Johnston (2007) have argued that ADAM generalized to a larger population of chronic drug users in the county. Although the methodology is complicated, the logic is simple. Let  $P_i$  represent the propensity score for the  $i^{\text{th}}$  respondent in the ADAM survey. Then  $1/P_i$  is a suitable weight for estimating prevalence for the two-week sampling period. Suppose there were two administrations of ADAM per year and that the two-week periods are representative of the bracketing six-month periods. Then a weight of  $4/(52P_i)$  is a suitable weight for estimating the number of substance abusers in the arrestee population for the year. Finally let  $Q_i$  represent the predicted arrest rate during the past year for the  $i^{\text{th}}$  respondent conditional on offender characteristics. Then  $1/(52P_iQ_i)$  is a suitable weight for estimating the number of chronic substance abusers in the county. Of course, to apply this weighting scheme, an analyst requires an estimate of  $Q_i$ . Rhodes, Kling and Johnston (2007) provide details.

Therefore ADAM can be used to estimate the number of chronic drug users in a county. The estimate is model-based and not as neat as simple estimates from a probability-based survey. However, no one has yet devised a probability-based survey of the general population that provides an acceptable estimate of the prevalence of chronic drug abuse.

Using model-based procedures to estimate the number of chronic drug users in a county does not deal with the problem that the current version of ADAM is a purposeful sample of just ten counties, so an analyst cannot produce justifiable national estimates. However, this current limitation to ADAM could be eliminated with a larger probability-based sample of counties. The earlier version of ADAM had (at some time) forty-one large counties including some counties that paid for their own ADAM programs. Using the data from these large counties, we have used ratio-estimation procedures (by combining ADAM and TEDS data) to derive national estimates of the number of chronic drug users, how much they spend on drugs, and the total amount of drugs that they use. These estimates enter into two reports for the Office of National Drug Control Policy – one providing consumption-based estimates and the other providing supply-based estimates – that are currently being prepared for a general audience.

## Using ADAM to Study Other Policy Questions

ADAM is referenced as a survey of drug use among arrestees, but it is more than a survey of drug use. The ADAM instrument was carefully crafted and tested to address other issues. Except for questions that the NSDUH asks marijuana users, ADAM is the only repeated survey that questions respondents about recent drug market behaviors: How much they spend on drugs, how they buy them, and so on. These estimates are central to ONDCP's estimates of expenditures, but furthermore, market-based questions would seem to be an untapped source of intelligence for evaluating enforcement practices.

Although informed by other drug abuse research, ADAM's calendar is an innovative way to capture significant events that happened in the last year for a population that is repeatedly involved with the CJS. Significant events include arrests, treatment admissions, hospital admissions, homelessness, and so

on. We used ADAM calendar data for a HRSE/HAB study that required understanding insurance among individuals with HIV/AIDS. Nevertheless, with some exceptions (including a discussion as part of this meeting), ADAM's calendar data are underutilized.

More importantly, perhaps, ADAM provides a research platform for studying other behaviors of interest to both criminal justice and public health. Nothing prevents adding occasional addenda questions to ADAM, and in fact this was done in the earlier version of ADAM to study the possession of weapons.

## Conclusions

We understand that NIJ/BJA are contemplating major changes to the ADAM program. One possible change is to sample *sentenced* offenders in jails and prisons. An advantage is that a jail/prison-based sampling frame would lead to national estimates for prevalence and trends at (presumably) a lower cost than expanding the number of ADAM sites. There are disadvantages that can be encapsulated as: Estimates based on jail/prison populations do not estimate what is of greatest interest to public policy.

ADAM is advantageous because it captures drug users who are more representative of chronic users in the community. Frankly, estimating the prevalence of drug use among those involved with the criminal justice system does not justify a large-scale repeated survey. For the past twenty years, illegal drug use has been prevalent among individuals processed by the CJS, and it seems of marginal value to repeatedly affirm this observation. More important is that drug use by arrestees is a reflection of drug use among a larger population of chronic drug users, who are underrepresented by conventional surveys, including the NSDUH. An ADAM sample based on bookings better reflects the population of ultimate interest than would a survey of a sentenced population.

ADAM is advantageous because it captures *recent* behaviors. This is most apparent when asking arrestees about drug market activity. A sample of sentenced offenders can only report historical behaviors – those behaviors that happened before incarceration. The period between arrest and conviction is so unusual as to be uninteresting given the research questions, so practically a survey of the sentenced population would ask about a distant period before the offender was arrested, not a desirable feature of a survey where recall may be a problem. Furthermore, there is no ready confirmatory test for truthfulness given the limits of hair bioassay. Finally, a prison-based survey would not be especially timely because it would capture historical rather than current use and market activity.

Jails and prisons provide an attractive environment for survey research. The environments are stable and sampling is relatively straightforward. In contrast to many jail settings, computerized interviewing seems feasible and desirable. However, **we urge NIJ/BJA to decide on research questions first and then decide on methodology.** The latter should not determine the former.

Finally, over the last decade, we have been disappointed that ADAM has received so little funding for methodological development. Perhaps the new sponsorship by BJA and NIJ will rectify that deficiency. We have already seen a solicitation for a BJA fellowship to work on ADAM-related problems, and today's meeting further demonstrates a desire to advance ADAM-based methodology.