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Effectiveness of Partial Drug Testing: Evaluation of an Acceptance Sampling Approach

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EFFECTIVENESS OF PARTIAL DRUG TESTING: EVALUATION OF AN ACCEPTANCE SAMPLING APPROACH

ABSTRACT

Partial testing of collected urine specimens provides one opportunity for reducing the costs of a drug testing program--particularly if the partial testing can be done without an attendant rise in the proportion of the population testing positive for drugs. Partial testing of a population of items is routine in manufacturing where statistical quality control procedures include sampling plans that identify how many units of a production run are to be tested. One approach to quality control is acceptance sampling, which uses a sampling plan that minimizes the expected total cost of the quality control program. The sampling plan consists of the number of items to be tested and a decision rule that specifies under which sampling outcomes the entire population should be tested. A field evaluation of the acceptance sampling approach to drug testing was conducted in intensive drug supervision programs in probation offices in six Illinois counties. Sampling plans were identified for drug testing programs that required less than 100 percent testing of collected urine specimens and that yielded expected total costs lower than the current approach of 100 percent testing. The amount of feedback on drug tests provided to probation officers and, thus, to probationers was controlled during the evaluation. Counties were assigned to one of three feedback conditions: no feedback, random portion of feedback based on an acceptance sampling plan, or 100 percent feedback. *Results show that the counties using acceptance sampling could have reduced testing without increasing the proportion of those testing positive.* The percent testing positive increased throughout the study in the counties with zero feedback.

EFFECTIVENESS OF PARTIAL DRUG TESTING: EVALUATION OF AN ACCEPTANCE SAMPLING APPROACH

1.0 INTRODUCTION

Urine testing for the use of illegal drugs (urinalysis) has evolved as a routine part of supervision for many offenders on probation or parole. Drug testing programs are applied to detect and monitor the use of illegal drugs as well as to deter drug use through the threat of sanctions for positive results (e.g., see Wish and Gropper, 1990). As noted by Wish and Gropper (1990, p. 330), "Monitoring programs may also deter persons not being tested from using drugs. This is the primary rationale for random testing in the workplace." Several researchers have found that urine testing reduces drug use in criminal justice populations (e.g., Carver, 1989; Collins, 1989; and Latessa, 1991).

Recognition of the effectiveness of testing does not answer either the question of how much to test or the question of whether it is necessary to test all collected urine specimens. Recently, Kennedy (1993) conducted an experiment in which only one-third of the test results from collected urine specimens were reported back to probation officers--simulating a testing program in which only one-third of collected specimens were tested. His results showed no increase in the percent of positive specimens, leading him to suggest "urine collection alone may produce a sufficient perception of vulnerability to deter continued drug use" (Kennedy, 1993, p. 3). Kennedy's experiment was of very short duration and the one-third test ratio was determined arbitrarily. However, if the same results could be identified over a sustained period, agencies would have greater flexibility in the allocation of their drug-testing resources. Specifically, agencies could reallocate testing dollars to other purposes (e.g., treatment) or could collect more specimens (e.g., more frequently or from other populations).

The Kennedy experiment raised two closely linked questions: (1) "Can a non-arbitrary way to determine what proportion of collected urine specimens to test be developed?"; and (2) "Can agencies reduce the proportion of collected specimens that they test without increasing drug use within the tested population?" (i.e., "Can Kennedy's findings be replicated?"). In this report, we suggest that the answer to both questions is "yes." With respect to the first, statistical quality control has been used in manufacturing for decades to determine the proportion of a population of items to test for defects. Acceptance sampling is a quality control procedure that is particularly applicable to drug-testing programs (see Baker *et al.*, 1993). Acceptance sampling plans can be developed that identify the amount of urine testing necessary to minimize the expected total costs of the drug-testing program, taking into account not only the costs of the urine tests but also the costs associated with failing to detect drug use and the costs of treating (or punishing) those who test positive. The acceptance sampling plan specifies both how many to test and how many positive results are "too many" before additional action is required (for example, testing the entire population).

Acceptance-sampling-based drug-testing programs were developed and evaluated in a field study conducted in Intensive Drug Supervision Probation (IDSP) programs in six county probation offices in Illinois.[1] The IDSP programs are designed to monitor probationers with a history of drug use or abuse. The IDSP protocol for the frequency and timing of urine collection specifies three phases of testing. In Phase I, urine specimens are collected once a week; in Phases II and III, urine specimens are collected once a month and less frequently, respectively. Participants also are subject to testing "for cause." Prior to our evaluation, all collected urine specimens were tested and the results were reported to the probation officers. Failure of an IDSP probationer to "stay clean" can result in movement to a more frequent testing Phase or to the application of sanctions or referral to treatment. For a complete description of the IDSP program and

[1] The program names differ slightly in the six counties. For convenience, we will refer to them all as Intensive Drug Supervision Probation or IDSP programs.

some preliminary results on the effectiveness of partial drug testing of a population, see Kennedy (1993).

The purpose of the current evaluation was to determine whether less than 100 percent of collected urine specimens could be analyzed without a subsequent rise in the proportion of urine specimens testing positive. This study compared the effectiveness of testing only a proportion of collected specimens as specified by an acceptance sampling plan with (1) testing 100 percent of collected specimens and (2) no testing of collected specimens. This study did not attempt to determine an optimal plan for urine specimen collection. We assumed that urine collection protocols (i.e., the frequency with which specimens were collected) were exogenous to the experimental design and concentrated on identifying the optimal number of collected specimens to test rather the protocol for scheduling specimen collection.

In the next section, we describe the acceptance sampling drug testing program. Subsequently, we describe the experimental design and the data collected during the baseline and experimental study periods. Section 5 describes the results of the evaluation and Section 6 discusses the potential cost savings associated with an acceptance sampling drug testing program. Section 7 presents our conclusions.

2.0 ACCEPTANCE SAMPLING DRUG TESTING PROGRAM

Acceptance sampling is an approach to quality control often used in manufacturing.[2] In manufacturing, you have a population (or "lot") of items to be inspected--for example, a day's production of automobile tires. The manufacturer using acceptance sampling develops a sampling plan based on the total costs associated with the sampling plan--the inspection costs, the acceptance costs associated with failing to identify defective items, and the rejection costs associated with repairing or scrapping defective items. For our tire manufacturer, acceptance costs could include lawsuits due to injuries or loss of goodwill; the rejection costs could include the cost of repairs or the costs associated with scrapping the defective item.

The acceptance sampling plan consists of two numbers:

1) n, the number to be tested or sample size, and
2) a, the acceptance number that identifies when the number of defective items in the sample is "too many" (from a total-cost-minimizing perspective).

Acceptance sampling therefore provides an approach to the design of economical (cost-minimizing) partial-testing plans.[3] The decision rule that results in 100-percent testing of all collected specimens is "built into" the acceptance sampling plan and is what distinguishes acceptance sampling from other partial testing approaches in which you would always test, for example, 25 percent.

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[2] For a general discussion of acceptance sampling see, for example, Duncan, 1974. For a discussion of Bayesian acceptance sampling applied to drug testing, see Baker *et al.*, 1993.

[3] Note that the optimal sampling plan could specify 100-percent testing or no testing--depending upon the costs identified for the program. For our study, the sampling plans required between zero percent testing and 100 percent testing.

When applied to a drug testing program, acceptance sampling identifies the sampling plan (n^*, a^*) that minimizes total drug-testing program costs. These costs include the costs of:

1) Collecting and testing urine specimens for drugs--the inspection costs;
2) Imposing a sanction and/or providing treatment in response to a positive test for drugs--the rejection costs; and
3) Failing to identify a positive user at the time of testing--the acceptance costs.

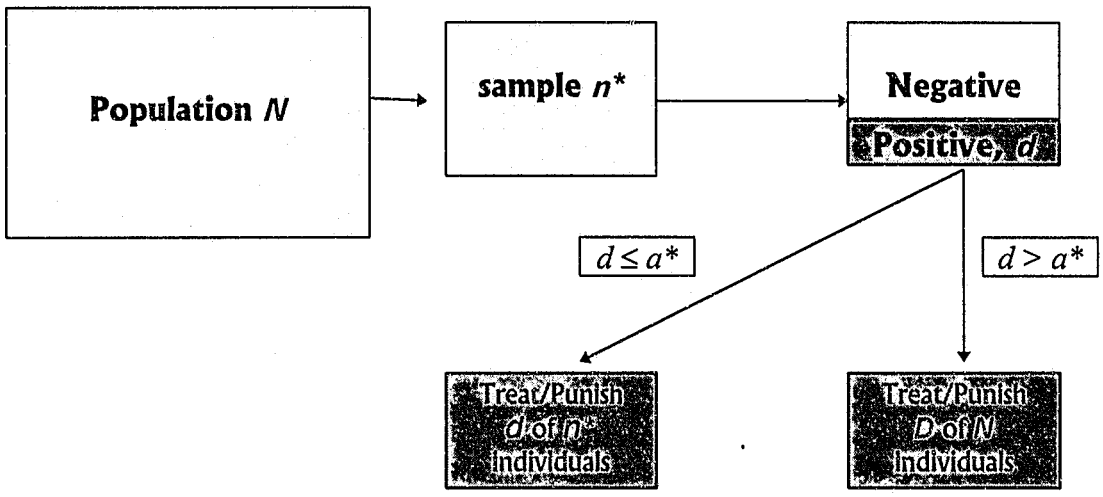
In addition to these costs, estimates of the underlying proportion of drug use in the population are used, as described in more detailed below.

We make the following definitions in the development of the acceptance sampling approach for drug testing programs:

1) A population ("lot") consists of N urine specimens collected during a short period of time. Here, N is the number of specimens collected during a one-week period.
2) A urine specimen is "defective" if it tests positive for one or more illegal drugs. In this study, tests were conducted routinely for cannabis and cocaine and somewhat less frequently for opiates.

An acceptance sampling drug-testing program is shown in Figure 1. From the population of N specimens, n^* specimens are selected randomly for testing. Of the tested specimens, d are identified as positive for one or more drugs. If "too many" are positive, in other words if $d > a^*$, additional action is required. We assume that if $d > a^*$, the entire population is tested, and D positive specimens are identified. All positive test results are followed by treatment or punishment of the probationers.

Figure 1. Acceptance Sampling Drug-Testing Program



In the remainder of this section, we provide details on the expected total cost model that allows us to identify the cost-minimizing sampling plans, (n^*, a^*).

2.1 Inspection Costs

The inspection costs (IC) are the costs directly associated with collecting and testing a urine specimen and are given by the following:

$$IC = (c_C \cdot N + c_U \cdot n) \tag{1}$$

where c_C = the cost of collecting a urine specimen;

c_U = the cost of performing the urinalysis drug test;

n = the sample size; and

N = the size of the population.

Here, we assume that specimens are collected from the entire population, i.e. the group subject to testing during that one-week period.[4] The *IC* include not only the cost of analyzing the urine specimen but also the specimen collection costs (e.g., the costs of the specimen containers, of chain of custody procedures, and of probation officers' time devoted to collection).

2.2 Expected Rejection Costs

The expected rejection costs (*ERC*) consist of the costs of treating or punishing those probationers identified as testing positive for drug use. The *ERC* are a function of the number of probationers expected to be identified as positive for drug use and the costs of treating or punishing each. The *ERC* is defined as follows:

$$ERC = \left[c_U(N-n) + c_T \cdot \sum_{D=0}^{N} [D \cdot g(D)] \right] \cdot (1 - PA). \qquad (2)$$

where c_T = the cost per incident of a treatment or sanction;

D = the number of users in the population;

$g(D)$ = the prior distribution of users in the population;

PA = the probability of "accepting" the population, i.e. the probability that a or fewer positive specimens will occur among the n specimens that are tested; and

other terms are as previously defined.

The probability of accepting the population, *PA*, is:

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[4] Acceptance sampling does not require that we collect all N urine specimens. We could instead collect n specimens. However, if the lot were to fail--i.e., more than a of the n were to test positive--and only n specimens had been collected, it would be necessary to recall the remaining (N - n) subjects to obtain urine specimens. Several problems might arise. First, it may not be possible to locate all (N - n) subjects, particularly if it becomes known that they are being sought for this purpose. Second, the cost of recall may not be negligible. Third, we assume that the population is homogeneous, an assumption which may be compromised if there is a time lag between the sample collection and the recall (for example, suppose the recall were done on Monday). An alternative strategy for the application of acceptance sampling based drug testing is to collect only n specimens in a given period. If more than a test positive, we could collect/test all N subjects who arrive in the next period.

$$PA = \sum_{D=0}^{N} \sum_{d=0}^{a} h(d|D) \cdot g(D) \qquad (3)$$

where $h(d|D)$ = the hypergeometric probability of finding d positive specimens (users) in a sample of n specimens when there are D positive specimens (users) in the N population.

The cost of treatment/sanction, c_T, requires additional discussion. In manufacturing, this cost would simply be the cost of repairing (or discarding) the defective unit. For the drug user, there is no single "repair" response nor is there any response that will be 100-percent effective. Thus, as described in Section 4, we identify c_T as a weighted average of the costs of effective treatment/sanction.

2.3 Expected Acceptance Costs

The expected acceptance costs (*EAC*) identify the costs associated with failing to detect a positive urine specimen. The expected acceptance costs include, e.g., the costs of crimes committed because an individual was not detected and sanctioned and the costs of lost productivity due to drug use. The *EAC* is:

$$EAC = \sum_{D=0}^{N} \sum_{d=0}^{a} \left[c_A \cdot (D-d) + c_T \cdot d \right] \cdot h(d|D) \cdot g(D). \qquad (4)$$

where c_A = the cost of failing to detect a user or the acceptance cost;

and other terms are as previously defined. Note from Equation (3) that Equation (4) includes PA, the probability of accepting the sample. As with c_T, c_A reflects a variety and not simply one type of costs.

2.4 Expected Total Costs and the Acceptance Sampling Plan

Given Equations (1) through (4), the expected total costs (*ETC*) of the drug testing program are identified as:

$$ETC = IC + ERC + EAC \qquad (5)$$

The acceptance sampling plan is then identified as the (n^*, a^*) pair that minimizes *ETC*, where n^* is the optimal sample size and a^* is the optimal acceptance number.

3.0 EXPERIMENTAL DESIGN

The study began November 1, 1993, and continued through June/July 1994. IDSP programs in six Illinois counties participated in the study. Table 1 shows the evaluation schedule.

Table 1. ICJIA/NIJ Acceptance Sampling Field Study Dates

Start Date	Activity	End Date	Interval
11/1/93	Baseline data collection	1/17/94	Weekly
12/1/93	IDSP program participants intake data collected and submitted to ICJIA	6/30/94	Probationers in programs as of 12/1 plus those entering system; updated weekly
12/7/93	PO time utilization data collection	6/30/94	Randomly by day
1/17/94	Experiment: experimental levels of feedback on test results; individual test result data collected	6/30/94	Weekly; feedback to sites as available

Note: The length of county participation varied somewhat. All participated from November 1, 1993, but the end date varied from June 7 for Sangamon County through July 29 for St. Clair.

During the baseline period (November 1, 1993 - January 17, 1994), drug test result data were collected in each county. These data were used to identify the prior distributions over positive test results for the acceptance sampling counties and to construct process control charts to monitor drug use for each county. Individual-level demographic, drug usage, and criminal history data on program participants also were collected beginning November 1, 1993. Time utilization data for probation officers (POs) were collected beginning on December 7, 1993, and continued at random throughout the study period. The time utilization data were collected to provide a baseline against which to identify subsequently any changes in the proportion of time spent by the POs on drug testing

activities. Experimental levels of feedback for the acceptance sampling and the zero-feedback group began on January 17, 1994. The experiment concluded on about July 1, 1994. Data collection ended June 7 in Sangamon County, June 13 in Madison County, June 30 in DuPage and Kane Counties, July 13 in McHenry, and July 29 in St. Clair.

The six IDSP programs were assigned to three experimental groups. The group assignment determined the amount of feedback of drug test results provided to probation officers and, therefore, to probationers. The protocol for the timing and frequency of specimen collection was the same for all three groups, random or at the time of an appointment. The frequency of urine specimen collection was determined by the IDSP program Phase. When feedback was provided, results were returned to the probation offices within one week and probationers were informed as to the outcome per office protocol. All six counties were sent charts on a weekly basis that tracked the average drug use behavior of their populations over the study period. For the zero-feedback counties, these charts were the only information provided on drug-testing outcomes throughout the experimental period.

Each experimental condition was applied in two counties. The experimental conditions were as follows:

1) **Zero Feedback (Group I).** In these counties, urine specimens were collected and all were tested. Test results were sent to the ICJIA on a weekly basis. None of the results was provided to probation officers during the experimental period. Probation officers were instructed to inform probationers of the likelihood of testing as follows: (a) inform the probationer when the specimen is provided that it may not be tested; and (b) tell the probationer at the next visit that the specimen was not selected for testing. Note that the probationer was not informed of a specific probability of testing--only that not all specimens were being tested.
2) **Acceptance Sampling (Group II).** In these counties, urine specimens were collected and all were tested. All test results were sent to the ICJIA where the

results to be reported back to the probation officers were determined by the acceptance sampling plan (see below). Again, as described above, probation officers informed the probationers that not all specimens would be tested. If results for a specimen were not received, the probation officer was instructed to simply tell the probationer that the specimen was not tested.

3) **100-Percent Feedback (Group III).** In these counties, urine specimens were collected and all were tested. The results were given to probation officers as usual. Results were also sent to ICJIA.

Table 2 shows the site assignments by experimental condition.

Table 2. Experimental Assignment by County

Experimental Assignment		
Group I **Zero Feedback**	**Group II** **Acceptance Sampling**	**Group III** **100% Feedback**
Madison St. Clair	DuPage Kane	McHenry Sangamon

The collection of urine specimens for the Group I and Group II probationers was done so that the identity of the specimen was confidential. Each probationer was assigned a study identification number; labels containing only a barcode representation of the identification number were prepared by the evaluation team and sent to the probation offices.[5] These labels were affixed to the specimen container and test results were identified only by this identification number. The "crosswalk" between the study identification numbers and the probationers' identities was maintained in data files at the

[5] Note that the study identification number and the county case number were the same for the Madison County subjects. All results were channeled through the IDSP supervisor who assured that results were not passed back to the probation officers.

Illinois Criminal Justice Information Authority. Test results were reported back to the sites by the probation department identification numbers.

Group II probationers' urine test results underwent acceptance sampling on a weekly basis. A cost model was developed for each of the two counties during the baseline period (see section 4.1). These models allowed us to identify optimal sampling plans of sample size (n^*) and acceptance number (a^*). As the number of specimens collected and tested each week varied, plans were identified for a variety of numbers of specimens (N). The protocol for applying the acceptance sampling approach was as follows:

1) N urine specimens were collected each week.
2) All N urine specimens were tested as usual either by the county or its contractor. (The specimens and results were identified only by the study identification numbers.)
3) All results were sent to ICJIA.
4) The weekly results were randomly ordered and the first n^* were examined to determine whether they were positive for one or more drugs.
5) If the number of positive urine specimens (positive for any drug) exceeded a^*, all N urine specimen results were reported to the probation officer and to the probationers.
6) If there were a^* or fewer positive urine specimens in the n^* specimens, only the n^* results were reported back to the probation office and the probationers.

The optimal (cost-minimizing) acceptance sampling plans for DuPage and Kane Counties are shown in Table 3. The costs that were used to develop these plans are described in Section 4.

Table 3: Optimal Acceptance Sampling Plans For DuPage and Kane Counties

DuPage County			Kane County		
N	n^*	a^*	N	n^*	a^*
1	1	1	1	1	1
2	2	0	2	2	0
3	3	0	3	3	0
4	4	0	4	4	1
5	5	0	5	5	1
6	6	0	6	5	1
7	6	0	7	7	2
8	7	0	8	7	2
9	8	0	9	8	2
10	9	1	10	9	3
11	10	1	11	10	3
12	11	1	12	10	3
13	12	1	13	11	3
14	11	1	14	12	4
15	12	1	15	13	4
16	13	1	16	13	4
17	13	1	17	15	5
18	13	1	18	15	5
19	14	1	19	16	5
20	16	2	20	17	6
21	16	2	21	18	6
22	17	2	22	18	6
23	18	2	23	19	6
24	17	2	24	20	7
25	18	2	25	21	7
26	18	2	26	20	7
27	18	2	27	23	8
28	18	2	28	22	8
29	19	2	29	23	8
30	21	3	30	25	9

Note: Sample size, n^*, and acceptance number, a^*, that minimize expected total costs for each N.

The optimal sampling plans reduced the amount of testing required each week, but the actual number of tests "saved" each week was relatively small. For example, for DuPage County with $N = 15$ the optimal sampling plan is (12, 1). The ETC^* for this optimal plan is $5,803 which compares favorably with a cost of about $6,480 for screening (100% testing). Thus, when N is 15, the acceptance sampling plan will generally reduce the number of tests by 20 percent (3/15) and reduce expected total costs by about 10 percent. The reduction in number of tests performed, however, is "only" three.[6]

For a practitioner, saving "only three" tests each week might seem unreasonable in the sense that the savings in drug tests might appear small relative to the "trouble" of implementing an acceptance sampling approach. Fortunately, it turns out that a variety of sampling plans can be identified that are "nearly optimal"--in the sense that they reduce total costs when compared with 100-percent testing and greatly reduce the amount of testing specified.[7] For example, for DuPage County and $N = 15$, when $n = 3$ and $a = 1$ ETC increases by only 4.1 percent over the optimal plan of (12, 1). Thus, the sampling plan (3, 1) reduces testing by as much as 80 percent (12/15) with only a small increase in costs. Therefore, the (3, 1) sampling plan is more "reasonable" in helping the county achieve two goals:

1) Reducing the total costs of the drug testing program and
2) Reducing the overall amount of urine specimens tested.

We identified near-optimal sampling plans for both counties for a variety of values of N. These sampling plans (n^{**}, a^{**}) were identified to minimize n and

[6] The number of tests saved is small partly because the size of the population of specimens on a weekly basis is small. If N were 300, a 20 percent savings in number of tests conducted would be more meaningful.

[7] Chase and Aquilano (1992, p. 653) note that because of the shape of the cost function, a high degree of accuracy in the identification of the sampling plan is not necessary to obtain the major portion of the benefit of the acceptance sampling approach.

maximize a within a given range of ETC. Specifically, the near-optimal sampling plans met the following criteria:

1) Expected total cost is within five-percent of the minimum expected total cost (ETC^*);
2) n^{**} is the smallest sample size for each N given criterion (1); and
3) a^{**} is the largest acceptance number, given criteria (1) and (2).

Table 4 shows these near-optimal sampling plans for DuPage and Kane county.

The sampling plans shown in Table 3 were used from January 17, 1994, through April 3, 1994, or April 10, 1994, for Kane and DuPage Counties, respectively. Subsequently, the sampling plans shown in Table 4 were used.

Group III's experimental condition was to maintain the *status quo* of 100-percent feedback. Specimens were collected and tested as usual. Results of all tests were reported back to the probationers. Results were also sent to ICJIA for entry in the study data base.

Table 4. Near-Optimal Acceptance Sampling Plans

DuPage County			Kane County		
N	*n***	*a***	*N*	*n***	*a***
1	1	1	1	1	1
2	2	0	2	2	0
3	1	0	3	3	0
4	2	0	4	4	1
5	2	0	5	4	1
6	1	0	6	4	1
7	2	0	7	3	0
8	2	0	8	6	2
9	2	0	9	6	2
10	2	1	10	6	2
11	2	1	11	6	2
12	2	1	12	6	2
13	2	1	13	6	2
14	2	1	14	7	2
15	3	1	15	7	2
16	2	1	16	7	2
17	4	1	17	7	2
18	3	1	18	7	2
19	3	1	19	7	2
20	2	1	20	7	2
21	1	1	21	7	2
22	2	1	22	7	2
23	1	1	23	7	2
24	2	1	24	7	2
25	2	1	25	7	2
26	2	1	26	7	2
27	3	1	27	7	2
28	3	1	28	7	2
29	2	1	29	7	2
30	2	1	30	7	2

Note: Sample size, n^{**}, and acceptance number, a^{**}, that yield expected total costs within 5 percent of the minimum *ETC* for each *N*. Other criteria are to minimize *n* and maximize *a* within 5 percent of the *ETC* (see text).

4.0 DATA

Data collection began November 1, 1993, and continued through June 1994. Four types of data were collected at all sites--cost data, drug test results, demographic information characterizing the probationers, and time utilization data showing how probation officers used their time. The cost and drug test data are described in Sections 4.1 and 4.2, respectively. The study subjects are described in Section 4.3. The time utilization data are described in the Appendix.

4.1 Cost Data

Development of the acceptance sampling cost models for DuPage and Kane Counties required estimation of the costs associated with the drug testing program. The Expected Total Cost model has the following components:

1) Inspection Costs;
2) Rejection Costs; and
3) Acceptance costs.

Each of these costs was estimated for each probation office in DuPage and Kane Counties.[8] The costs were elicited using a semi-structured interview. Respondents were given as much latitude as possible to respond to the questions.

The total inspection costs include the costs of the urine testing procedure, the cost of specimen containers, the chain of custody costs, report costs, analyst's time, and probation officer's time devoted to specimen collection and paperwork. The cost of a time-based input was based on the hourly wage of the employee; the entire procedure including collection, transportation, and testing generally required 30 minutes. The total inspection costs were estimated at $25 in both DuPage and Kane Counties.

[8]Kane county has two offices, each staffed by one probation officer who works with the intensive drug supervision program. DuPage has one office which is staffed with three probation officers who work with this program.

The second cost component, c_T, represented the cost of treatment or sanction for those probationers testing positive for drug use. Probation officers were asked to summarize the procedure used when a probationer tested positive, what criteria were used to determine the type of treatment or sanction applied, conditions under which each was likely to be imposed, and the officer's subjective assessment of the probability that a treatment/sanction would curtail use of drugs over a finite time horizon. Treatments ranged from mandatory attendance at twelve-step programs to in-patient programs; sanctions varied from a "slap on the wrist" to incarceration. The subjective probability is important in determining the expected cost of a given component, as we are interested in the cost of effective treatment/sanction. For example, a treatment program may cost $1,000/person. However, if the efficacy (i.e., the likelihood that an individual who completes the program will desist from taking drugs) is 10 percent, the effective cost of the program is $1,000/0.1 or $10,000. Given that the success of treatments for drug use/abuse are very low and that the likelihood that a sanction will be imposed (for example, the probability of a probationer returning to prison because of drug use) is small, the real costs associated with treatment and/or sanction are orders of magnitude higher than their accounting costs. The subjective probability and the likelihood of a treatment or sanction being used also depends on the previous test results for an individual. Thus, the first positive test may generate a treatment response (or a very minor sanction) while the fifth positive test may generate a probation revocation and a jail/prison term. The frequency of use of each option was also collected and it was assumed that this distribution would reflect the distribution of the number of times any one individual tested positive.

The average cost of treatment/sanction was elicited from the probation officers by generating a list of the various options, and associated distribution information. The following information was collected for the $j = 1, 2, ..., M$ options identified by each probation officer:

1) Type of treatment or sanction;

2) Cost of treatment or sanction (c_j);
3) Frequency of application (p_j); and
4) Perceived effectiveness of treatment/sanction (e_j).

Then, the average cost of treatment/sanction weighted by effectiveness was determined as

$$c_T = \sum_{j=1}^{M} (c_j \cdot p_j / e_j) \qquad (6)$$

where $\sum_{j=1}^{M} p_j = 1$

These costs were estimated as $1600 for DuPage County and $1625 for Kane County.

The last cost to be elicited was the most subjective--the penalty associated with failing to detect a positive drug use, or the acceptance cost. These represent the costs to society of negative behavior associated with drug use. After considering a variety of options for eliciting this information, we used an approach similar to that which we used to elicit the treatment/sanction costs. Specifically, we asked the probation officers to

- identify specific costs,
- attach a money value to those costs, and
- attach a frequency to those costs. The frequency was defined relative to "every 100 probationers"--i.e., "How often would you expect *x* to occur for every one hundred drug using probationers?"

The likelihood that an individual who is positive for drug use on any given drug test will be involved in a property or violent offense may be relatively small. However, the costs associated with such an event is extremely high from the standpoint of society. It is difficult, however, to attribute an incident to a single occasion's drug use. We gathered some interesting information from the probation officers for these costs, but were unable

to get sufficient, reliable acceptance cost information to set acceptance costs. Thus, we reverted to the determination of whether it was reasonable to assume that acceptance and rejection costs were approximately equal. Specifically, we asked whether the acceptance cost for a single incident was less than, approximately equal to, or greater than the rejection cost. All probation officers responded that the acceptance cost (or penalty) was probably greater than, but not significantly greater than, the rejection cost.

Given the input obtained from the probation officers in DuPage and Kane county, we estimated the costs of treatment and sanction options to range from $1,600 to $1,625, as previously reported. We therefore set the acceptance costs to be the same as the rejection costs.

4.2 Baseline Drug Test Results

Drug test results data were collected throughout the evaluation. During the baseline period (November 1, 1993, through January 17, 1994), all counties collected and processed urine specimens as usual. Results were reported back to the probation officers as usual. Data on the urinalysis results were mailed on a weekly basis to ICJIA. These data were used to:

1) Estimate a prior distribution of drug use for the two acceptance sampling counties; and
2) Construct statistical process control charts ("*p*-charts") for monitoring the use of drugs over the period of the experiment.

These *p*-charts, described below, were particularly important for the Group I sites as they provided the only measure of the level of drug use among the IDSP program participants throughout the experimental period.

Table 5 shows the percentage of positive urine specimens for each county during the baseline period. On average, the percentage of specimens that were positive for one or more drugs ranged from 19 percent to 42 percent. McHenry County had the lowest proportion of positive tests; Kane County had the highest.

Table 5. Positive Urine Test Results by County, Baseline Period (11/1/93-1/17/94)

County	Group Assignment	Total Tests	Total Positive	Positive (%)
Madison	0 % Feedback	408	149	36.5
St. Clair		285	97	34.0
DuPage	Acceptance Sampling	166	44	26.5
Kane		170	72	42.4
McHenry	100 % Feedback	204	39	19.1
Sangamon		191	59	30.9
Total		1424	460	

One method used to monitor the proportion of positive specimens was through a statistical process control chart or *p*-chart. The *p*-chart is a visual record of the behavior over time of a population based on a selected attribute. In this case, the attribute of interest is the proportion of urine specimens which test positive for any drug. (For a complete discussion of *p*-charts, see Duncan, 1976.) These charts were prepared for each county on a weekly basis to provide information on the level of drug use in the population. The control chart represents a confidence interval on the proportion of users in a population. The mean of the confidence interval is the overall average percentage positive computed as:

$$\bar{p} = \frac{\sum_{i=1}^{k} p_i}{\sum_{i=1}^{k} n_i}, \qquad (7)$$

where p_i is the number of positives in the ith sample n_i, and k is the number of samples collected.[9] The control limits are computed using the standard error of proportion,

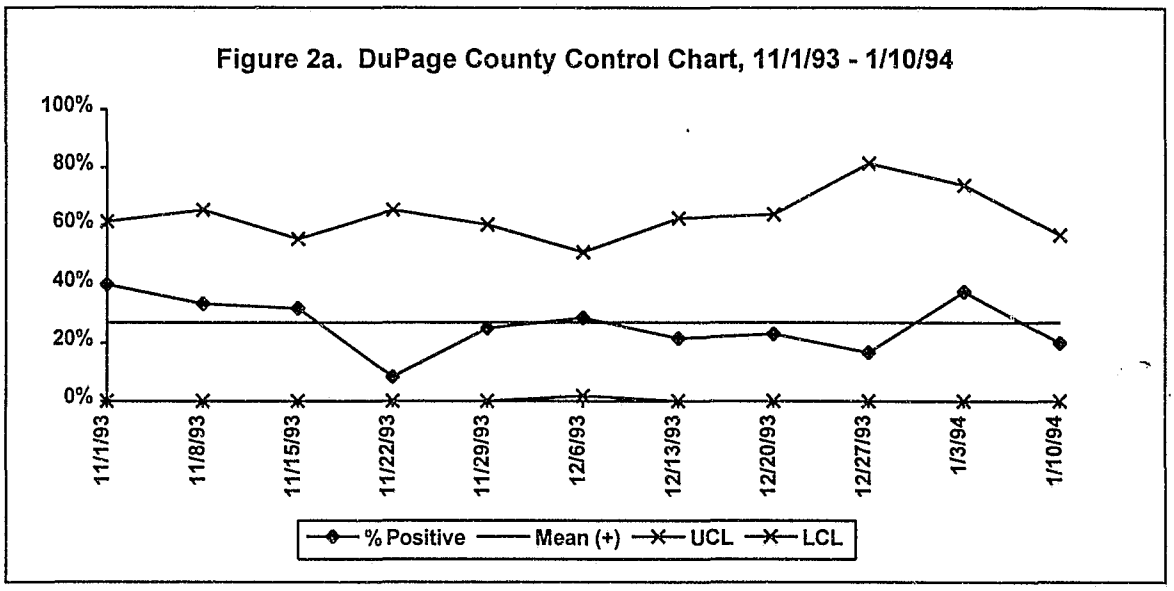
$$\sigma_{\bar{p}} = \sqrt{\frac{\bar{p}(1-\bar{p})}{n_i}}, \qquad (8)$$

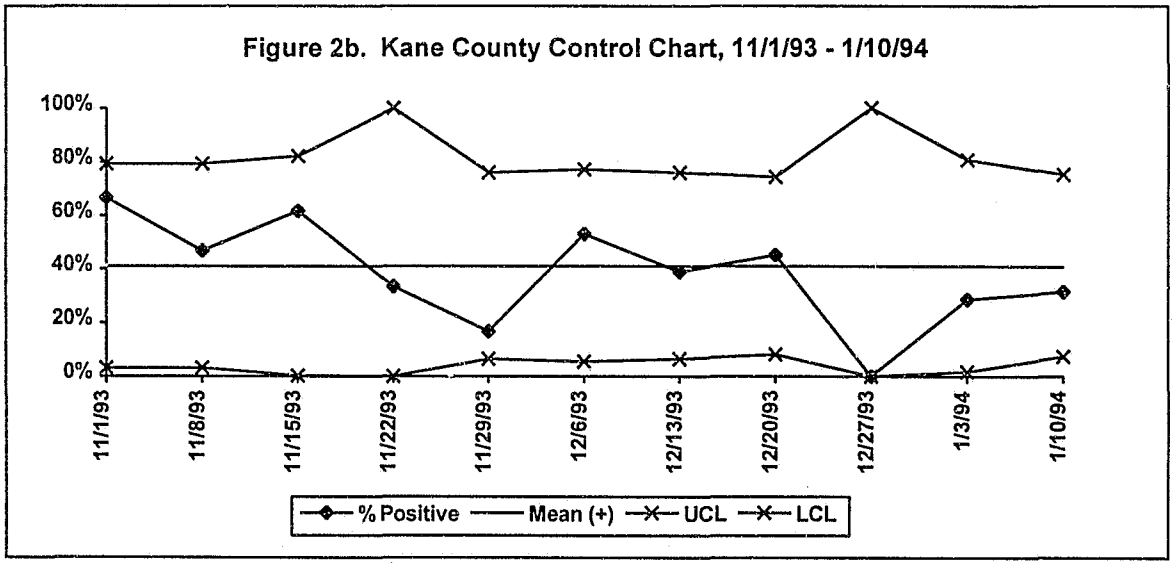
where n_i is the sample size for the ith sample. The control limits for each week were set at $\bar{p} \pm 3\sigma$.[10]

The p-charts supplied to each county were updated throughout the experiment on a weekly basis to monitor the percent positives over time. Figures 2a and 2b show the control charts for DuPage and Kane Counties during the baseline period.

[9] The proportion of defectives follows a binomial distribution. Use of this distribution assumes that there is sampling with replacement; this is true in the short run for this population. For example, even if probationers test positive for an illegal drug, it is unlikely that they will receive a sanction or treatment that will immediately remove them from the case load of a probation officer. However, when the sample sizes are "not small", the binomial can be approximated by using the normal distribution.

[10] The control limits of the p-charts were set at $\pm 3\sigma$ from the proportion positive. There is a Type I error 0.0023, or a 0.23 percent chance that a weekly mean proportion of positives randomly fall outside of the control limits. This increases the sensitivity of the p-charts to random error and testing error but reduces the Type II error associated with the process. Type II errors are a problem when sample sizes are not large, which is the case with some of our weekly data.





The prior distributions for use in the ETC models were developed from the baseline data. These probability distributions describe the probability of there being x proportion of positive test results in each week's group of tests. Table 6 shows the prior distributions for testing positive for any drug for DuPage and Kane counties. The two

distributions differ dramatically. For example, there is an 80-percent probability that between 21 and 40 percent of all urine specimens tested in DuPage County will be positive for one or more drugs. In Kane County, there is only a 37-percent probability that the percent of positive tests will fall in the 21-to-40-percent range. Higher percent-positives are much more likely in Kane County than in DuPage.

Table 6. Prior Distributions for Acceptance Sampling Counties

Proportion of Urine Specimens Testing Positive	Probability	
	DuPage County	Kane County
0.00 - 0.2	0.15	0.16
0.21 - 0.4	0.80	0.37
0.41 - 0.6	0.00	0.32
0.61 - 0.8	0.05	0.16
0.81 - 1.0	0.00	0.00

Note: Distributions identified during the baseline period. The second and third columns show the probability of observing the proportion of positive urine specimens shown in column one.

4.3 Subject Characteristics

Subject information was collected on all probationers who were in the IDSP programs between November 1, 1993 and July 1, 1994. An intake data form was provided, but the probation officers were allowed to provide the data in any format which was convenient. The intake data items were:

- Probation ID number
- Name
- Gender (M/F)
- Race (Black/White/Hispanic/Asian/Other)
- Date of birth
- Probation officer

- County
- Date probation began
- Date program participation began
- Conviction offense(s) (Robbery, Rape, Assault, Burglary, Theft, Possession, Delivery, Other)
- Number of previous convictions (misdemeanors and felonies only; excluding traffic offenses)

Individuals who had their probation revoked and were subsequently reassigned to the program were treated as new cases.

The total number of probationers enrolled in the programs during the course of the study was 931. The numbers of probationers enrolled in the experiment and the number of releases from January 17, 1994 to June 30, 1994 are shown by county in Table 7. The flow of probationers indicates some differences by county. Madison, which had the largest number of participants (N = 333), had the smallest percent terminated (18 percent). DuPage County had 130 participants, with a termination percentage of 38.

Table 7. Population Flow by County

County	N	Terminations	Percentage Terminated
Group I: Madison	333	59	17.7
Group I: St. Clair	125	46	36.8
Group II: DuPage	130	49	37.7
Group II: Kane	109	33	30.3
Group III: McHenry	86	20	23.3
Group III: Sangamon	148	36	24.3
Total	931	243	26.1

For the 243 probationers (26%) terminated from the IDSP program during the study period, the average length of time in the IDSP program was 469.6 days (s.d. = 263.6). The reasons for termination are shown in Table 8. Of those discharged, 60 percent were transferred and 30.4 percent were revoked and remanded to the custody of the Department of Corrections. Only 22 percent of those terminated completed their probation sentences and were discharged. A small percentage became fugitives; note that of the 7 "Others," two died. All six counties showed a similar distribution--namely, most probationers were terminated as a result of transfer or being remanded to the Department of Corrections.

Table 8. Reasons for Probationers Leaving Program

Reason for Program Termination	N	Percent
Transferred to Another County/Program	91	37.5
Revoked/Transferred to DOC	74	30.4
Completed Probation	54	22.2
Fugitive/Warrant	17	7.0
Other	7	2.9
Total	243	100.0

The average program participant was 28 years of age (mean = 28.4 years; s.d. = 8.1 years) at the time he/she began their probation. The mean age varied from 27.1 years (McHenry; s.d. = 7.0) to 30.6 years (s.d. = 7.9) in DuPage. The mean ages in the other counties were: 28.2 (Madison; s.d. = 7.8), 28.1 (St. Clair; s.d. = 8.4), 28.1 (Kane; s.d. = 8.7), and 28.4 (Sangamon; s.d. = 8.4).[11] The number of probationers by gender and race,

[11] An F-test showed the ages to be significantly different across the six counties; F = 2.6241, p-value = 0.0229.

by county, is shown in Table 9. As can be seen most participants were male and a majority (54.7 percent) were white.

Table 9. Number of Probationers by Gender and Race in Participating Counties

County	Males				Females		
	White	Black	Hisp	Total*	White	Black	Total*
Group I Madison	146	103	2	251	51	30	82
Group I St. Clair	27	80	0	108	6	11	17
Group II DuPage	77	23	4	107	14	7	23
Group II Kane	34	41	11	87	11	8	22
Group III McHenry	7	0	3	77	9		9
Group III Sangamon	45	72	0	117	17	14	31
Total	336	319	20	747	108	70	184

Note: Total includes categories of Other (1 Asian male in St. Clair and DuPage Counties; 1 Hispanic female in Madison County and 3 Hispanic females in Kane County) and missing.

Although a few probationers in the IDSP programs were on probation for violent crimes, most were on probation for drug offenses--either possession or delivery. Table 10 shows, by county, the offenses for which the IDSP program participants were on probation.[12] Also shown in Table 10 is the mean number of prior convictions for each county's IDSP population. Although the average number of prior offenses over all counties was 1.52 (s.d. = 3.45), 60 percent (553 of the 931 subjects) did not have a prior conviction. The extent to which the programs were reserved for "first timers" varied over the counties. In particular, Madison County's program was exclusively for first-time

[12] Totals vary from the county N's because some probationers were on probation for more than one offense. Specifically, 69 probationers had more than one offense. The offense charge was missing for 16 subjects.

offenders. In contrast those in St. Clair and Sangamon Counties, on average, had more than three prior convictions.

Table 10. Offense Type and Number of Previous Convictions

County	Current Offense				Mean Number of Prior Convictions (s.d.)
	Drugs	Property	Violent	Other	
Group I Madison	242	37	5	56	0 (0)
Group I St. Clair	56	40	4	30	3.56 (5.12)
Group II DuPage	80	19	3	28	1.49 (2.32)
Group II Kane	52	17	4	43	2.05 (2.66)
Group III McHenry	69	5	6	26	0.93 (1.59)
Group III Sangamon	96	29	5	25	3.16 (5.46)
Total	595	147	27	208	1.52 (3.45)

Note: Current offense is the offense for which the current probation term is being served. Violent includes assault, robbery, and rape; Property includes burglary and theft; Drugs includes possession and delivery. Some subjects had more than one offense; all offenses are included in the table.

5.0 RESULTS

Data on urine test results for individual participants were collected beginning November 1, 1993, and continuing throughout the evaluation; the experimental portion of the study began January 17, 1994. The drugs for which urine specimens were screened routinely were cocaine, cannabis (THC), and opiates (Madison County routinely had only a two-drug screen based on "drugs of choice"; cocaine and cannabis were the usual drug-test pair.). In some counties, tests also were conducted for less common drugs including PCP, methamphetamines, barbiturates, and others.

A total of 4107 urine specimens were collected and tested during the study. Table 11 shows the distribution of tests by type of drug, the total number of tests, and the number and percentage of positives. Most specimens were tested for more than one drug--yielding a total of 17,798 separate tests. The most common drug for which probationers tested positive was cannabis (21.7 percent), followed by cocaine (18.1 percent), and opiates (3.4 percent). Less than one percent of the population tested positive for any other drug (e.g., PCP, methamphetamines).

Table 11. Test Results by Drug Type

Drug Type	Number of Tests	Number Positive Tests	Positive (%)
Cocaine	4103	742	18.1
Cannabis	4100	891	21.7
Opiates	2700	91	3.4
PCP	1737	7	0.4
Methamphetamines	1732	4	0.2
Benzodiazapines	1728	16	0.9
Barbiturates	1702	1	0.1
Other	1	0	0.0
Total	17,798	1752	9.8

Note: "Number of tests" refers to the number of urine specimens tested for the indicated drug. A total of 4107 urine specimens were tested for one or more drugs.

Table 12 shows the number of urine specimens tested, the number of urine specimens that tested positive for *one or more* drugs, and the mean number of urine specimens collected per probationer by county. The average percent of specimens testing positive for at least one drug varied considerably across the sites, ranging from 17 percent (McHenry) to about 44 percent (St. Clair and Kane Counties). Across all sites, the average percent positive was 35.6 percent. The mean number of urine specimens collected from a probationer also varied considerably across sites, ranging from about three in Madison and Sangamon Counties to more than seven in St. Clair. The average number of specimens per probationer across all counties was 4.4--or slightly more than one test every two months.

Table 12. Drug Test Results by County

	Number of Tests by County						Total
	Madison	**St. Clair**	**DuPage**	**Kane**	**McHenry**	**Sangamon**	
Probationers (number)	333	125	130	109	86	148	931
Urine Specimens (number)	1057	951	608	504	533	454	4107
Specimens per Probationer (mean)	3.2	7.6	4.7	4.6	6.2	3.1	4.4
Positive Specimens (number)	415	416	179	219	90	142	1461
Positive Specimens (%)	39.3	43.7	29.4	43.4	16.9	31.3	35.6

Note: Positive indicates urine specimen tested positive for one or more drugs.

Table 13 shows the distribution over positive drug test results for each county. Cannabis is the most commonly found drug, followed by cocaine, in all counties. A total of 891 tests were positive for cannabis; 742 were positive for cocaine. Of the 4107 specimens tested, 2646 (or 64%) tested negative.

Table 18. Drug Test Results by Drug Type and County

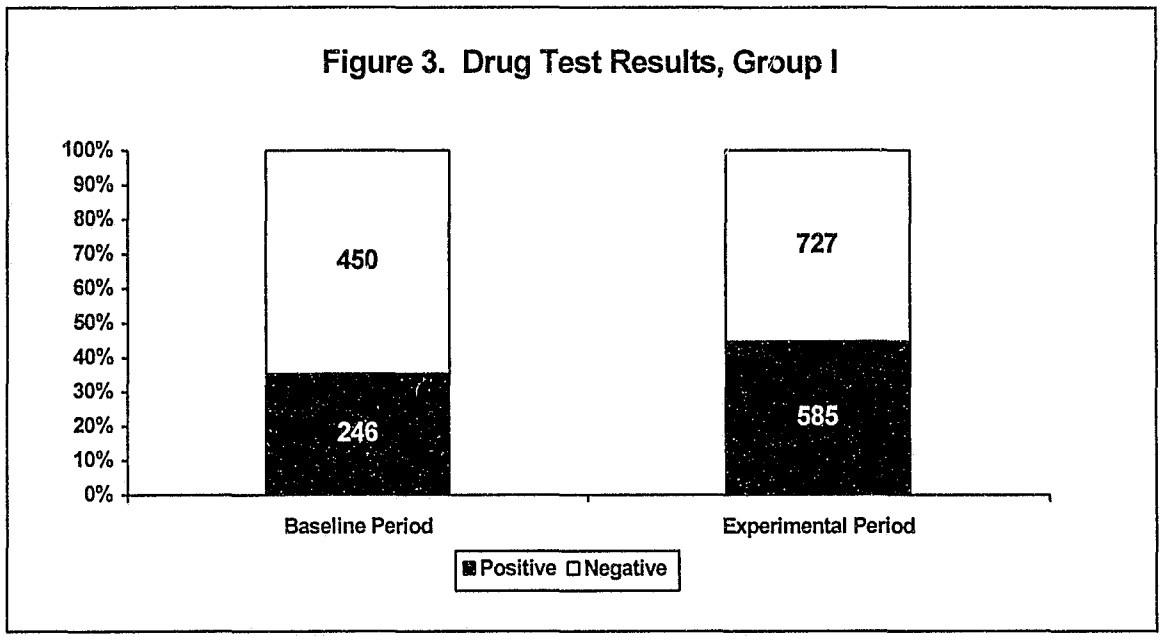
Test Positive for	County						Total
	Madison	St. Clair	DuPage	Kane	McHenry	Sangamon	
Cocaine	223	188	83	153	12	83	742
Cannabis	249	263	83	135	81	80	891
Opiates	5	41	37	6	1	1	91
Others	6	2	17	0	3	0	28
No Drug	642	535	429	285	443	312	2646

Note: "Others" include PCP, Methamphetamines, Benzodiazapines, Barbiturates, and Other. One specimen could test positive for one or more drugs.

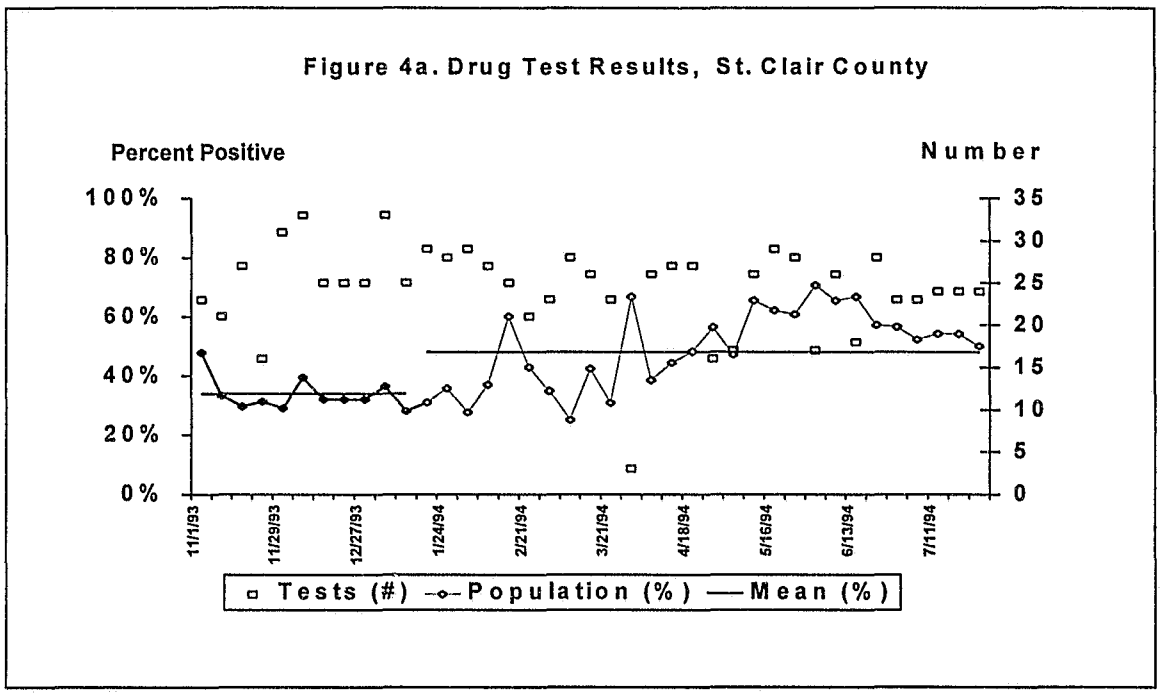
More detailed discussion of the findings by evaluation group follows. We discuss findings for the two comparison groups (Groups I and III) and then discuss the results for our experimental group (Group II).

5.1. Results for the Comparison Groups

Group I: Zero-Feedback Counties: Figure 3 summarizes the urine test results for the Group I counties during the two stages of the evaluation. As can be seen, a significantly greater percentage of specimens tested positive during the experimental period than during the baseline period when feedback of urine test results was provided. Specifically, 44.5 percent of the Group I specimens tested positive during the "no feedback" period versus 35.3 percent during the baseline period (F-statistic = 16.1308, p-value < 0.0001). This finding is consistent with the notion that specimen collection or urine testing alone without feedback may not provide an effective deterrent against drug use (as compared with testing with feedback).



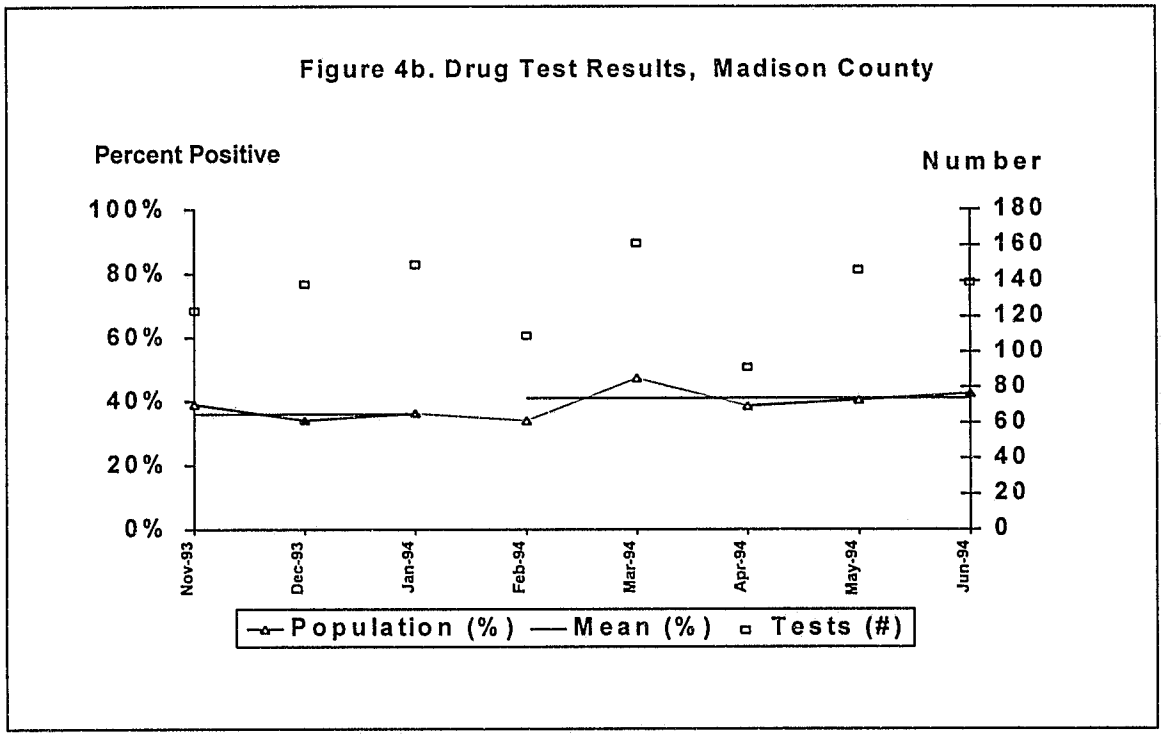
More detail with respect to the change over time in the percentage of specimens testing positive is shown in Figures 4a and 4b. These charts show the percentage of specimens that were positive for the Group I counties over the course of the evaluation. Figure 4a provides the results for St. Clair County. As can be seen, the proportion of specimens testing positive increases following the initiation of the experimental protocol--i.e., following the introduction of no feedback of urine test results on January 17,1994. Figure 4a also shows the mean percentage of specimens testing positive for the baseline and experimental periods. An average of 34 percent of specimens tested positive during the baseline compared with 48 percent during the experimental period (F-statistic = 15.8131, p-value < 0.0001). The number of tests conducted each week is also shown. As can be seen, the number of tests conducted each week remained stable throughout the experimental period, suggesting that probation officers did not reduce testing while they were receiving no test results during the course of the experiment.



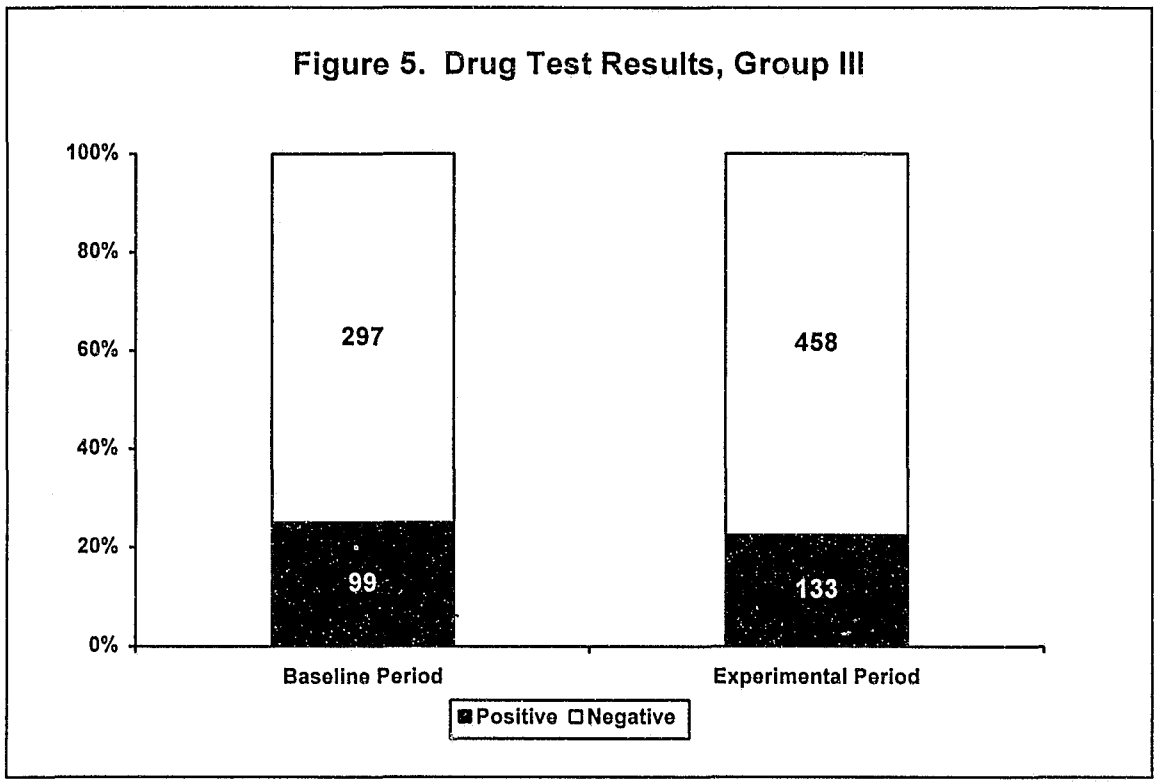
The effect of the no-feedback condition was not as pronounced in Madison County. Data from Madison were reported on a monthly basis.[1] For these analyses, we treated the months November 1993 through January 1994 as the baseline period and February through June 1994 as the experimental period. Figure 4b provides the monthly drug test results for Madison County. The percentage of specimens testing positive was somewhat greater following the initiation of zero feedback than it was during the baseline period (41 versus 36 percent), but not significantly so (F-statistic = 2.5546, p-value = 0.1103). (Drug treatment providers in Madison County conducted urine tests while those in St. Clair County relied on the testing conducted by the probation office. Thus,

[1] Madison County sent their urine specimens to an outside contractor for analysis. The logs for tests and test results were maintained with a monthly--not daily--notation. These are the results that were provided to the ICJIA.

probationers in Madison engaged in treatment were being tested while those in St. Clair effectively were not.)



Group III: 100 Percent Feedback: Figure 5 shows the results for the Group III counties, which had 100-percent drug-test result feedback throughout the study. As can be seen (and as would be expected barring changes external to the experiment), the percent of the populations testing positive did not change over the course of the experiment. Positive specimens were 25 and 22.5 percent during the baseline and experimental periods respectively (F-statistic = 0.8204, p-value = 0.3653).



Figures 6a and 6b show weekly test results for the 100-percent feedback counties, McHenry and Sangamon. There is no trend apparent in the percentage of positive test results for either county. For McHenry County, 19 and 16 percent of the specimens tested positive during the baseline and study periods, respectively (F-statistic = 1.1714, p-value = 0.2796). For Sangamon County, 31 percent of the specimens tested positive during both the baseline and study periods (F-statistic = 0.0001, p-value = 0.9914).

Figure 6a. Positive Drug Tests (%), McHenry County

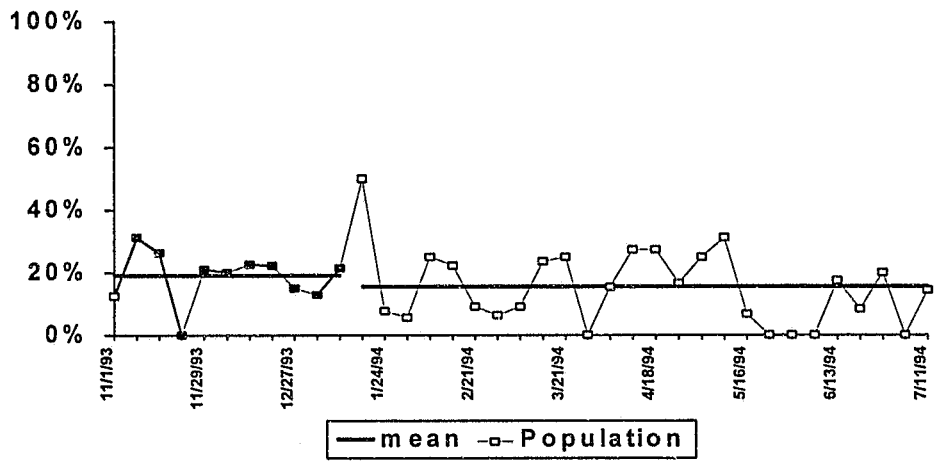
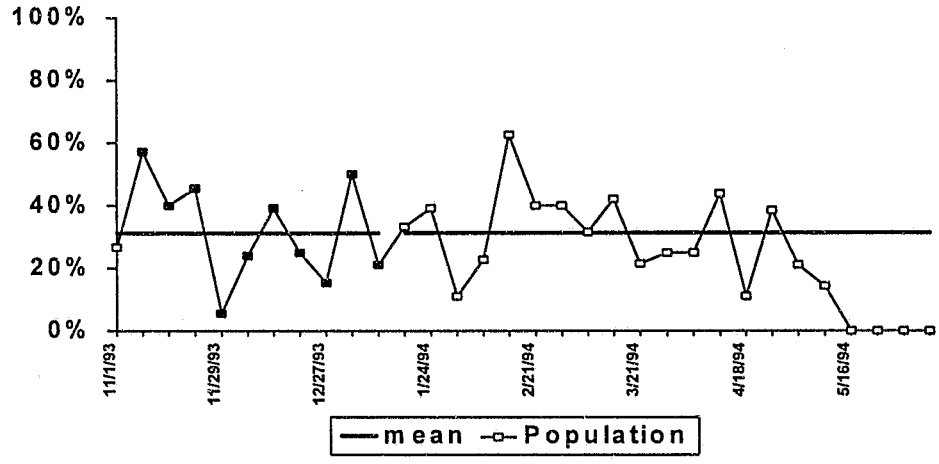


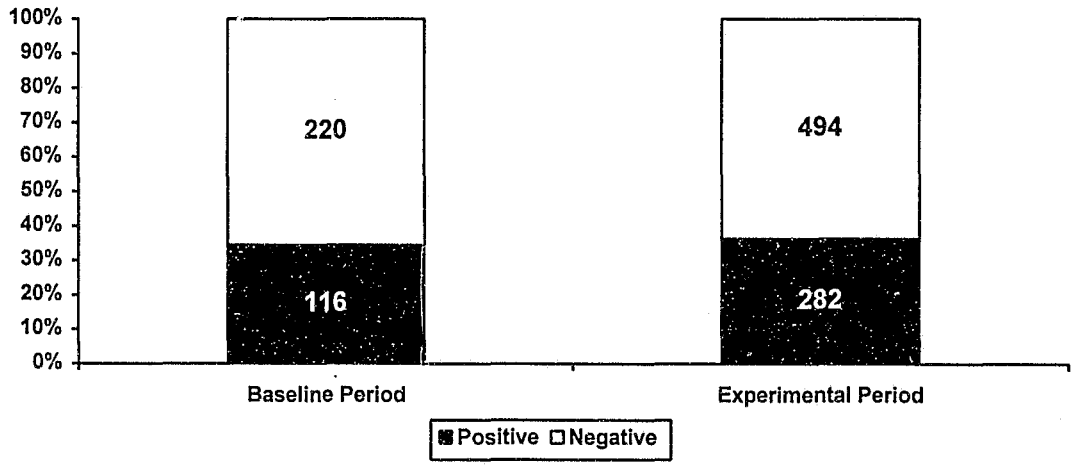
Figure 6b. Positive Drug Tests (%), Sangamon County



5.2 Results for the Experimental Group

Beginning on January 17, 1994, DuPage and Kane Counties' drug test results were reported according to the acceptance sampling plans shown in Tables 3 and 4 and the protocol described earlier. The optimal acceptance sampling plans were used from January 17, while the near-optimal plans were used beginning in April. Figure 7 compares the baseline and study test results for the Group II counties. As can be seen there is no difference in the percent testing positive between the two study periods. During the baseline, 35 percent of the specimens tested positive compared with 36 percent that tested positive during the experimental period (F-statistic = 0.3361, p-value = 0.5622).

Figure 7. Drug Test Results, Group II



The weekly results by county are consistent with the finding of no difference between periods. Figures 8a and 8b show the percentage of positive drug tests for these counties for the evaluation period. Figure 8a shows the results for DuPage County: the percentage of urine specimens testing positive in the population, the percentage testing positive in the acceptance sample, and the means for the two periods. The baseline mean

was 0.265 percent comparable to the 0.30 percent for the experimental period (F-test = 0.9451, p-value = 0.3313). Similar results obtain if we consider separately the experimental periods in which we were using the optimal or near-optimal acceptance sampling plans (implemented April 9, 1994). The means for the three periods (i.e., baseline, optimal plan, and near-optimal plan) were 0.265, 0.343, and 0.261, respectively (F-statistic = 2.3406, p-value = 0.0971). Note that the sample results "track" the population percentage positives closely, suggesting that the probation office could monitor the performance of the IDSP population through acceptance sampling.

Figure 8a. Positive Drug Tests (%), DuPage County

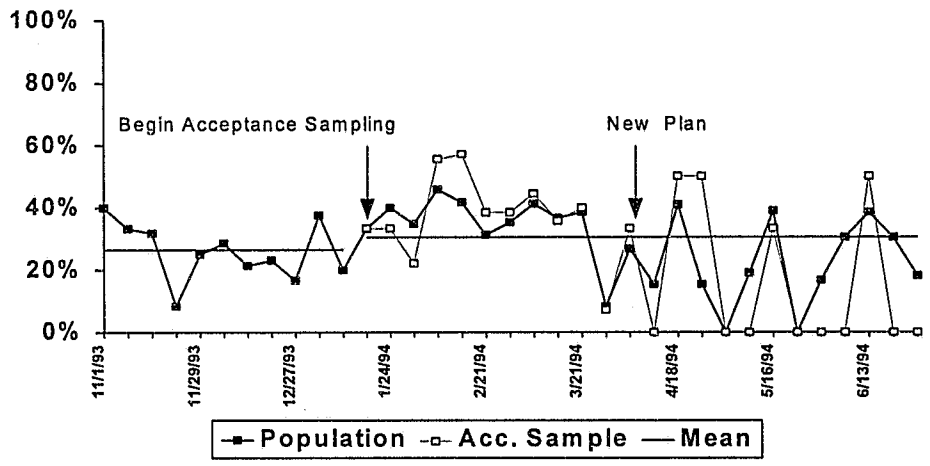


Figure 8b. Positive Drug Tests (%), Kane County

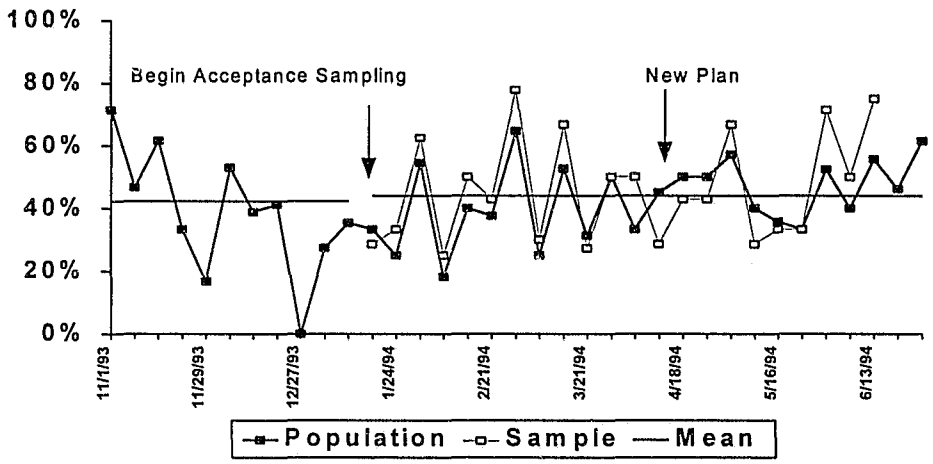


Figure 8b shows the percentage of positive drug tests for Kane county for the period November 1, 1993 through June 13, 1994. As in DuPage County, the optimal acceptance sampling plan was initiated on January 17, 1994; the near-optimal plans were implemented on April 4, 1994. The percentage of positive specimens is higher in Kane County than in DuPage. During the baseline period, 42.4 percent of the specimens tested positive, not significantly different from the 44.0 percent that tested positive during the experimental period (F-statistic = 0.1257, p-value = 0.7230). A similar result obtains if the periods under the different sampling plans are evaluated separately. Again, the baseline average percent positive was 42.4 compared with 40.4 percent positive under the optimal sampling plans and 46.8 under the near-optimal plans (F-statistic = 0.7453, p-value = 0.4751).

The results indicate that acceptance sampling did not increase the percentage of probationers testing positive for drugs. This is the same pattern which was present in the 100 percent (*status quo*) counties, as we show below. Partial testing as operationalized by Bayesian acceptance sampling appears to "do no harm."

6.0 SAVINGS FROM ACCEPTANCE SAMPLING

Testing collected urine specimens--represented in our experiment by both partial (Group II) and total (Group III) feedback of urinalysis results on collected specimens--appears to provide similar benefits when compared to "no testing," represented here by urine specimen collection with no feedback of results to either the probation officer or the probationer (Group I). *Given the similar results in terms of no effect on the percentage of the population testing positive, the benefit of an acceptance sampling approach to drug testing program is the potential for cost savings.* Additionally, the acceptance number indicates when "too many" are positive, providing a decision rule that suggests the need for additional action. In the case of our model, this action entails 100 percent testing of the populations.

Figure 9a shows the cumulative number of tests that would have been saved if DuPage County had followed the acceptance sampling plans used to report results. During the experimental period, 442 urine specimens were collected. Results of 192 tests were reported back to the probation office. Thus, DuPage could have "saved" 250 urine tests or 56.6 percent without decreasing the deterrent effect of their testing program. The savings are less dramatic but still meaningful in Kane County (Figure 9b). During the experimental period, 334 urine specimens were collected and results of 254 were reported. Eighty tests (24 percent) could have been "saved" over the six months.

Another perspective can be gained by examining representative expected total costs as generated by our model. For example, let's assume that Kane County collected an average of 30 urine specimens each week. The *ETC* of a screening program in which all 30 specimens were collected and tested and all probationers identified as positive were treated or sanctioned is about $12,852. The optimal sampling plan is (17, 6) which has an *ETC* of $10,367--a savings of 19.3 percent over screening. If we were to use the near-optimal plan from Table 4, we would use a sampling plan of (7, 2) and the *ETC* would be $10,830.51--a savings of 15.7 percent over the screening program.

Figure 9a. Drug Tests "Saved," DuPage County

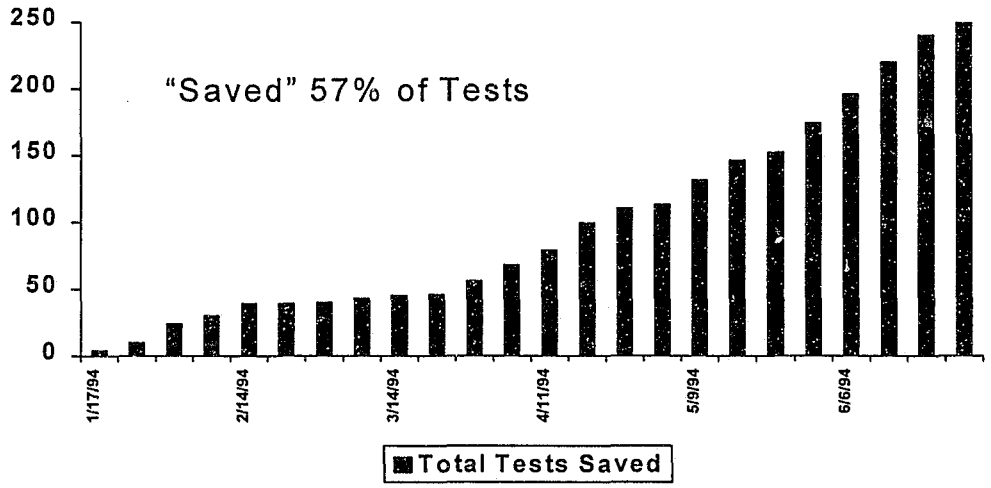
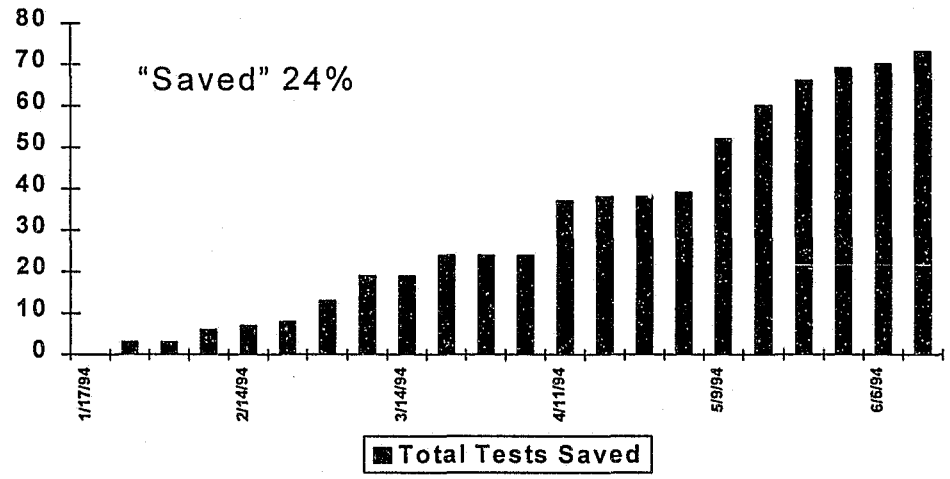


Figure 9b. Drug Tests "Saved," Kane County



7.0 CONCLUSIONS

The results of this study suggest that an acceptance sampling approach to drug testing may offer improvements over traditional approaches. In this study, acceptance sampling based drug testing was used in two counties for a six-month period without an increase in the proportion of the probation populations testing positive for drug use. The acceptance sampling plan is based on minimizing the expected total cost of conducting a drug testing program, including the costs of testing, treatment/sanction, and failing to detect drug users.

An acceptance sampling drug testing program:

1) Provides a sampling plan that identifies the number of specimens that should be tested in one period and does not require that the entire population be tested.
2) Frees resources for other uses.
3) Provides a decision rule against which it can be determined if "too many" of the population are testing positive for drugs--the acceptance number serving, from a practical standpoint, as a "gotcha number" that will prevent drug use from escalating in the population since the likelihood of 100-percent testing increases if more of the population think that they can use drugs without fear of being detected

The results from the two "zero feedback" counties suggest that feedback/response to drug test results does have an effect on the distribution of users. These findings, which were more pronounced for St. Clair than Madison County, lend support to the idea that drug testing serves as a deterrent, even when sanctions are modest (e.g., a "slap on the wrist" from a probation officer when one tests positive) and treatment is scarce.

Finally, we observed no differences in the percent of the populations testing positive for our "100 percent feedback" counties. These counties served as a benchmark

representation of the status quo. In the absence of changes external to the experiment, we expected no changes in the pre/post (baseline/experimental) comparisons and none was observed.

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APPENDIX

RESULTS OF TIME UTILIZATION DATA COLLECTION

One potential benefit of the acceptance sampling drug testing program--*if it can be implemented without an attendant increase in drug use*--is that time and resources previously used for urinalysis could be made available for other uses. This appendix describes the procedures for and the results of a time utilization study conducted in conjunction with this experiment. The results of this study provide baseline information on how probation officers were allocating their time. These data were collected between December 7, 1993 and June 30, 1994.

Work sampling was used to show the allocation of time and effort spent by each probation officer participating in this study on activities associated with the supervision and monitoring of probationers. Work sampling, a traditional work measurement used in operations management and industrial engineering, is the application of techniques to determine the proportion of time spent on performing particular activities. For our study, we were interested in determining the percentage of time probation officers spend in the activities associated with supervising IDSP probationers. The minutes per day engaged in the following work activities were collected:

- Face-to-face probationer contacts
- Collateral contacts (except service providers)
- Drug-related service provider contacts
- Other service provider contacts
- Urine specimen collection
- Drug-testing related paperwork
- Other paperwork
- Other (specify)

The instructions and the form used to collect data are included on the following pages.

December 2, 1993

«address»

Dear «name»:

Enclosed please find packets of forms to be distributed to your Intensive Drug Program probation officers for the time utilization component of our drug testing study. As you may recall, the purpose of this part of the study is to determine what impact the different protocols have on staff time allocation. The form is very short and should be completed at the end of the designated day.

Each officer should be given a packet. Each packet consists of forms coded with an id number (Name) and a series of dates. Each officer should be given a differently numbered packet. The numbers for the «county» officers are «poids».

Please note the following:

- The dates have been randomly selected and generally will vary from officer to officer.
- The form should be completed at the end of the designated day. If the officer is absent on the designated day, it should be indicated on the form. The officer should NOT complete the form on another day.

- Time is to be allocated in hours. Time in the office and time out of the office is to be accounted for separately.

- If time is spent on something other than the identified categories, the time should be allocated to "Other" and the officer should briefly specify the category.

- If a form is misplaced or if you hire additional officers for the drug program, please contact me for replacement(s) or additional forms.

For your information, I have also included a summary sheet that indicates the scheduled days for your officers.

The completed forms should be sent to:

<ICJIA>

We appreciate your cooperation on this important study. If you have any questions, please feel free to call me at (202)307-2961 or to call Ed Kennedy at (312)793-5142.

Sincerely,

Pamela K. Lattimore, Ph.D.
Senior Researcher
National Institute of Justice

enclosures

INTENSIVE DRUG PROGRAM TIME UTILIZATION STUDY

Please estimate the time you spent on each of the following tasks during the date shown below. Total office time and total field time should sum to the total number of hours you worked that day, excluding time for lunch. Time "in field" refers to all time out of the office.

Your responses will be kept confidential. Please place in a sealed envelope or fold and staple and return to the designated individual in your office.

Name: «po_id»

Date: «date»

ACTIVITY	IN OFFICE	IN FIELD	TOTAL
Vacation			
Holiday			
Sick/Other Leave			
Face-to-Face Probationer Contacts			
Collateral Contacts (except service providers)			
Drug-Related Service Provider Contacts			
Other Service Provider Contacts			
Urine Specimen Collection			
Drug-Testing Related Paperwork			
Other Paperwork			
In Court			
Other (please specify below or on page back)			
TOTAL TIME			

Procedures

Fifteen officers, representing all of the IDSP probation officers, participated. Each officer was asked to complete a work sampling form on approximately 13 days during the study period. The days were randomly selected. Of the 199 data collection forms distributed, 193 were returned for a 97 percent response rate. Table A1 shows the distribution of reports by officer and county.

Table A1. Time Utilization Data Collection

County	Number of Officers	Number of Forms	
		Distributed	Returned
Madison	3	40	38
St. Clair	3	36	35
DuPage	3	40	40
Kane	2	27	24
McHenry	2	28	28
Sangamon	2	28	28
TOTAL	**15**	**199**	**193**

As data collection did not begin until December and as we did not expect to observe large differences in time allocations during the baseline and experimental periods, we examined the data for the entire study period. We also were able to conduct cross-county comparisons.

Tables A2a - A2c show the results of the time utilization study. The tables show the minutes allocated to the various tasks, as well as the proportion of total time spent on each task by county. As can be seen in Table A2a, the probation officers in all counties spent a large proportion of their time meeting with probationers, although the proportion varies somewhat by county. Overall, 27 percent of officers' time was spent in face-to-face contact with probationers. On average, an additional four percent of officers' time was spent making collateral contacts (one to nine percent) and a total of eight percent of

the time was spent arranging drug treatment (one to nine percent) or other services (zero to three percent).

Table A2a. Probation Officer Time-Utilization Report Data: Contacts

Activity	Group I		Group II		Group III		Total
	Madison	St. Clair	DuPage	Kane	McHenry	Sangamon	
Contact with Probationer	5955 (0.35)	3339 (0.21)	4300 (0.25)	2630 (0.23)	3975 (0.35)	2565 (0.22)	22764 (0.27)
Collateral Contacts	775 (0.05)	836 (0.05)	665 (0.04)	140 (0.01)	975 (0.09)	330 (0.03)	3721 (0.04)
Drug-Related Services	870 (0.08)	1355 (0.08)	780 (0.05)	165 (0.01)	509 (0.04)	1005 (0.09)	4684 (0.06)
Other Services	445 (0.03)	485 (0.03)	210 (0.01)	40 (0.00)	345 (0.03)	90 (0.01)	1615 (0.02)
SUBTOTAL	**8045 (0.47)**	**6015 (0.38)**	**5955 (0.35)**	**2975 (0.26)**	**5804 (0.51)**	**3990 (0.34)**	**32784 (0.39)**
TOTAL	**16990**	**15933**	**16980**	**11325**	**11414**	**11805**	**84447**

Note: Entries are number of minutes (proportion of total minutes) by county.

Table A2b shows the time spent collecting urine specimens and preparing drug-testing related paperwork. Overall, twelve percent of probation officer time was spent in drug testing related activities. Again, there is variability across the counties, with total time spent ranging from 7 to 18 percent. Collection of urine specimens required from two-to-seven percent of officers' time, while preparing drug-testing paperwork accounted for three-to-eleven percent. The relatively small amount of time spent by DuPage officers collecting specimens (two percent) is attributable to the presence in that office of other individuals who conduct the urine testing. Even so, the DuPage County officers spent about five percent of their time doing drug-testing related paperwork.

Table A2b. Probation Officer Time-Utilization Report Data: Drug Testing

Activity	Group I		Group II		Group III		Total
	Madison	St. Clair	DuPage	Kane	McHenry	Sangamon	
Urine Specimen Collection	1225 (0.07)	982 (0.06)	380 (0.02)	765 (0.07)	444 (0.04)	345 (0.03)	4141 (0.05)
Paperwork	1885 (0.11)	1106 (0.07)	850 (0.05)	985 (0.09)	327 (0.03)	630 (0.05)	5783 (0.07)
SUBTOTAL	**3110 (0.18)**	**2088 (0.13)**	**1230 (0.07)**	**1750 (0.15)**	**771 (0.07)**	**975 (0.08)**	**9924 (0.12)**
TOTAL	**16990**	**15933**	**16980**	**11325**	**11414**	**11805**	**84447**

Note: Entries are number of minutes (proportion of total minutes) by county.

The other activities towards which officers' time was directed are summarized in Table A2c. Paperwork, other than drug-testing-related paperwork, consumed a substantial amount of time--twenty-one percent overall. Paperwork consumed the least time in Madison County (12%) and the largest amount of time (31%) in Sangamon County. Only a relatively small amount of time was spent in court--three percent overall. Finally, leave (vacation, holiday, or other) accounted for sixteen percent of time on average.

We also identified the amount of time officers spent in the office versus in the field. Table A3 shows the distributions by county. As can be seen, officers spend about three-fourths of their time in the office and about one-fourth of their time in the field--although again there is considerable variability by county. Madison officers reported spending the largest percentage of their time outside the office (47%), while the officers in St. Clair County reported spending the largest percentage of time in the office (88%).

Table A2c. Probation Officer Time-Utilization Report Data: Other

Activity	Group I		Group II		Group III		Total
	Madison	St. Clair	DuPage	Kane	McHenry	Sangamon	
Paperwork	2075	3747	4990	1890	1800	3565	18067
	(0.12)	(0.24)	(0.29)	(0.17)	(0.16)	(0.31)	(0.21)
Court	310	210	660	0	725	720	2625
	(0.02)	(0.01)	(0.04)	(0.00)	(0.06)	(0.06)	(0.03)
Other	510	1203	3065	840	514	1415	7547
	(0.03)	(0.08)	(0.18)	(0.07)	(0.04)	(0.12)	(0.09)
SUBTOTAL	**2895**	**5160**	**6015**	**2730**	**3039**	**5700**	**28239**
	(0.17)	**(0.32)**	**(0.35)**	**(0.24)**	**(0.27)**	**(0.48)**	**(0.33)**
Vacation	960	2220	0	1800	1350	630	6960
	(0.06)	(0.14)	(0.00)	(0.16)	(0.12)	(0.05)	(0.08)
Holiday	1620	0	900	900	450	0	3870
	(0.10)	(0.00)	(0.05)	(0.08)	(0.04)	(0.00)	(0.05)
Sick/Other Leave	360	450	180	1170	0	510	2670
	(0.02)	(0.03)	(0.01)	(0.11)	(0.00)	(0.04)	(0.03)
SUBTOTAL	**2940**	**2670**	**1080**	**3870**	**1800**	**1140**	**13500**
	(0.17)	**(0.17)**	**(0.06)**	**(0.34)**	**(0.16)**	**(0.10)**	**(0.16)**
TOTAL	**16990**	**15933**	**16980**	**11325**	**11414**	**11805**	**84447**

Note: Entries are number of minutes (proportion of total minutes) by county..

Table A3. Probation Officer Time-Utilization Report Data: Office v. Field Time

Activity	Group I		Group II		Group III		Total
	Madison	St. Clair	DuPage	Kane	McHenry	Sangamon	
Office	7440	11608	12770	5505	6691	8460	52474
	(0.53)	(0.88)	(0.80)	(0.74)	(0.70)	(0.79)	(0.74)
Field	6610	1655	3130	1950	2923	2205	18473
	(0.47)	(0.12)	(0.20)	(0.26)	(0.30)	(0.21)	(0.26)
SUBTOTAL	**14050**	**13263**	**15900**	**7455**	**9614**	**10665**	**70947**

Note: Entries are number of minutes (proportion of total minutes in office or field--i.e., total time exclusive of leave) by county.

Another analysis of interest to the current study is the issue of where urine specimen collection was conducted--i.e., in the office or in the field. Table A4 shows the

proportion of specimen collection conducted in the field and in the office by county. As can be seen, in three counties (DuPage, Kane and St. Clair), all urine specimens were collected in the office, while in two others (McHenry and Sangamon) most collection was done in the office. In contrast, 60-percent of the time Madison County officers spent collecting urine specimens was spent in the field.

Table A4. Probation Officer Time-Utilization Report Data: Office v. Field Urine-Specimen Collection Time

Activity	Group I		Group II		Group III		Total
	Madison	St. Clair	DuPage	Kane	McHenry	Sangamon	
Office	485	982	380	765	384	300	3296
	(0.40)	(1.00)	(1.00)	(1.00)	(0.86)	(0.87)	
Field	740	0	0	0	60	45	845
	(0.60)	(0.00)	(0.00)	(0.00)	(0.14)	(0.13)	
SUBTOTAL	**1225**	**982**	**380**	**765**	**444**	**345**	**4141**

Note: Entries are number of minutes (proportion of total minutes collecting urine specimens) by county.

Finally, Table A5 provides summary data by study group for time allocation minus leave time. There are differences in the allocation of time by the probation officers both by county and by experimental group. These differences are presumed to be the result of county-level policies and procedures and to be independent of the study. In any event, each county acts as its own "control" in our pre-/post design.

Table A5. Summary of Time-Utilization Report Data by Experimental Group

Activity	Group I	Group II	Group III	Total
Contacts	14060	8930	9794	**32784**
	(0.51)	(0.38)	(0.48)	**(0.46)**
Drug Test	5198	2980	1746	**9924**
	(0.19)	(0.13)	(0.09)	**(0.14)**
Other	8055	11445	8739	**28239**
	(0.29)	(0.49)	(0.43)	**(0.40)**
Total	**27313**	**23355**	**20279**	**70947**

Note: Entries are number of minutes (column proportion).