Utilization and Cost Effectiveness of Standardized Testing for Screening and Confirmation of Drugs of Abuse in Urine

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Abstract. Screening and confirmation testing for drugs of abuse in urine (DAU) represent areas for potential reduction of laboratory workload and attendant cost savings. Following a careful review of the clinical needs of the underlying veteran patient population served by 7 medical facilities in the Boston area, DAU test ordering frequencies, positive rates for several screening panels and the associated confirmation tests, DAU panel standardization, and confirmation testing only by request were introduced. These changes were all reviewed and approved by the clinician users of DAU testing at each institution before the changes were implemented. Before standardization of DAU screening panels, 59,835 DAU screening requests were done at a cost of $216,005; following standardization, there was 47% decrease in DAU screening utilization (27,876) and costs ($100,633). Before implementation of a DAU confirmation by request only policy, 5,331 confirmation tests were done at a cost of $111,502; after institution of the confirmation policy, there was 95% decrease in confirmation tests (5,080) and costs ($105,826). DAU panel standardization and DAU confirmation by request only have resulted in substantial reductions of laboratory workload and costs in a veterans population and may serve as a model for other patient populations with perhaps similar outcomes. (received 9 March 2002; accepted 20 May 2002)

Keywords: drugs of abuse in urine, assay standardization, confirmation, utilization, cost analysis

Introduction

In the present era of shrinking healthcare resources and emphasis on cost effective laboratory utilization, the clinical laboratory is challenged by a need to decrease its utilization and control its costs. The administrators of the VA Boston Healthcare System, which comprises 4 separate medical centers and 3 outpatient facilities, decided to review the utilization and costs for screening and confirmatory testing of drugs of abuse in urine (DAU) to determine whether DAU utilization and costs could be decreased by adopting a standardized approach to DAU testing.

The clinical scientists and managers of the laboratory hypothesized that DAU utilization and costs could be significantly reduced by (a) standardization of DAU panels and (2) adoption of a uniform policy of confirmation by request only of an initially positive DAU screening test.

To test the first hypothesis, data for test utilization and costs were initially collected over a 6-mo period. Based on these data, the clinical laboratory recommended standardization of DAU panels for the VA Boston Healthcare System. This recommendation was presented to the medical staff at each site for approval. A second study was then done over 6 mo to determine the impact of standardization of DAU panels on DAU utilization and costs.

To test the second hypothesis, data for DAU confirmation utilization and costs were initially collected over 6 mo and the DAU confirmation policy at each site was verified, namely that each site confirmed every positive DAU screening test by a second analytical method. The laboratory then
recommended adoption of a DAU confirmation by request only for the VA Boston Healthcare System and presented this recommendation to the medical staff at each site for approval. A second study was then done over 6 mo to determine the impact of the DAU confirmation by request only policy on DAU confirmation utilization and costs.

Materials and Methods

Medical facilities and patients. The medical centers and outpatient facilities in the VA Boston Healthcare System consist of 4 medical centers, including 1 full service tertiary care facility, with complete medical and surgical services, centralized laboratory testing, and emergency department; 2 predominantly psychiatric facilities with no medical or surgical services; and 1 medical center with outpatient clinics, emergency and psychiatric services, but no medical or surgical services. In addition, the VA Boston Healthcare System includes 2 outpatient facilities with limited laboratory services, and 1 outpatient facility with a methadone program clinic. The patient population studied was predominantly male veterans patients, who were in drug rehabilitation and treatment programs in inpatient, outpatient, and long-term care settings.

Drugs of Abuse in Urine (DAU). All DAU were available in panels or as a discrete DAU test. Tests were available for urine amphetamines, barbiturates, benzodiazepines, cannabinoids, cocaine and metabolites, methadone and metabolites, opiates, and propoxyphene.

Screening of DAU. Reagent kits for enzyme-multiplied immunoassays (EMIT, Syva Co., Cupertino, CA) were used to screen for the following DAU: amphetamines, barbiturates, benzodiazepines, cannabinoids, cocaine and metabolites, methadone and metabolites, opiates, and propoxyphene [1]. The Olympus AU640 instrument (Olympus Corp., Melville, NY) was used according to the standard Olympus operating procedure for immunoassay drug screening. Cutoff levels for negative/positive screening for DAU were as follows: amphetamines, 1000 ng/ml; barbiturates, 200 ng/ml; benzodiazepines, 200 ng/ml; cannabinoids, 50 ng/ml; cocaine, 300 ng/ml; methadone, 300 ng/ml; opiates, 300 ng/ml; and propoxyphene, 300 ng/ml.

Confirmation of DAU. The Remidi HS Drug Profiling System (Bio-Rad, Hercules, CA), a high performance liquid chromatography (HPLC) analytical instrument, was used to confirm the DAU screening tests. Benzodiazepines confirmation: Bio-Rad Urine Benzodiazepine (UBZ) HPLC columns and reagents were used to confirm the presence of up to 11 benzodiazepines [2]. HPLC results were reported as confirmed positive/negative and when appropriate the specific DAU was identified. Amphetamines, cocaine and metabolites, methadone and metabolites, opiates, propoxyphene confirmation: Bio-Rad Drug Profiling System (DPS) HPLC columns and reagents were used to confirm the presence of these basic drugs [2]. HPLC results were reported as positive/negative and when appropriate the specific DAU was identified. Barbiturates and cannabinoids confirmation: Confirmation was performed by a reference laboratory (Quest Diagnostics, Cambridge, MA) by gas chromatography/mass spectrometry (GC/MS). The results were reported as positive/negative for cannabinoids.

Data Collection. The VA computer system (VISTA) was used to collect data for site-specific DAU panels as well as data for DAU screening and confirmation volume by site using the search data inquiry option.

Cost Analysis. The Decision Support System (DSS) of the VA Boston Healthcare System provided data for laboratory test costs based on an analysis and accounting for total direct and indirect costs. Direct costs included reagent consumables and all related instrument costs, all labor costs including fringe benefits, and supervisory, administrative and pathologist expenses. Indirect costs included laboratory costs such as phlebotomy, specimen collection and transport, accessioning, information systems, and other elements of laboratory-only overhead; medical center costs included utilities, telephone, hospital computer system, and other overhead conventionally borne by the medical center.
DSS-Derived Laboratory Test Costs:
Screening test of individual DAU by EMIT = $3.61.
Confirmation HPLC test = $19.34.
Confirmation GC/MS test (reference lab) = $65.00.
Total costs for individual DAU confirmation and screening were calculated by multiplying the total number of DAU by the DSS-derived laboratory test costs.

Results

There was marked variation in the individual drugs and available panels for DAU testing at each site within the VA Boston Healthcare System. Available DAU panels varied from 3 to 8 individual DAU with considerable overlap among the panels. Benzodiazepines, cocaine, and opiates were present in all of the DAU panels.

Table 1 summarizes data for the entire VA Boston Healthcare System for DAU screening and confirmation testing. Over a 6-mo period (January to June 2000) a total of 65,166 individual DAU tests were performed; 59,835 (91.8%) were DAU screening tests, while the remaining 5,331 (8.2%) were DAU confirmation tests. The 3 most frequently ordered DAU screening tests were benzodiazepines, cocaine, and opiates, which were ordered in approximately the same number and frequency (14.9%) and which collectively accounted for 49% of total DAU screening tests and 45% of total DAU test requests. In contrast, the 3 most frequently confirmed positive DAU drugs were methadone, benzodiazepines, and opiates, which collectively constituted 83% of DAU confirmation tests, but only 6.8% of total DAU test requests.

The methadone clinic was the source of 2,682 requests for methadone test requests (59% of total); 2,311 of these requests were screened as positive with a confirmation rate of 97.9%, suggesting that methadone should be offered in a specific DAU for such patients. Patients who were not in the methadone program (1,867, or 41% of total) had a positive screening rate for methadone of only 2.1% and a positive confirmation rate of 90%, suggesting that methadone screening should not be part of a routine DAU panel of tests for this patient population.

Based on the results in Table 1, the following laboratory recommendations were presented to the medical board of each of the sites in the VA Boston Healthcare System for approval: (a) screening panels should be standardized from 7 available panels to a single DAU screening panel consisting of the 3 most frequently ordered DAU screening tests (benzodiazepines, opiates, cocaine); (b) DAU screening requests for amphetamines, barbiturates, cannabinoids, barbiturates, methadone, and propoxyphene would need to be added by request to this standard DAU panel; (c) amphetamines should be excluded from the standardized DAU panel based on the zero % confirmation rate for positive amphetamine screening tests; (d) barbiturates should be excluded from the standardized DAU panel based on the very low screen positive rate (0.4%); (e) cannabinoids should be excluded from the standardized DAU panel.

Table 1. Tests for drugs of abuse in urine (DAU) at the VA Boston Healthcare System from January to June 2000.

<table>
<thead>
<tr>
<th></th>
<th>Screened tests (n)</th>
<th>% of all tests</th>
<th>Positive screening tests (n)</th>
<th>% Positive screening tests</th>
<th>Confirming tests (n)</th>
<th>% of all tests</th>
<th>Positive confirming tests (n)</th>
<th>% Positive confirming tests</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amphetamines</td>
<td>5,827</td>
<td>8.9</td>
<td>204</td>
<td>3.5</td>
<td>204</td>
<td>0.3</td>
<td>0</td>
<td>0</td>
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<tr>
<td>Barbiturates</td>
<td>7,191</td>
<td>11.0</td>
<td>31</td>
<td>0.4</td>
<td>31</td>
<td>0.05</td>
<td>13</td>
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<td>9,721</td>
<td>14.9</td>
<td>1,429</td>
<td>14.7</td>
<td>1,429</td>
<td>2.2</td>
<td>1,359</td>
<td>95.0</td>
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<td>Cannabinoids</td>
<td>7,970</td>
<td>12.2</td>
<td>153</td>
<td>1.9</td>
<td>153</td>
<td>0.2</td>
<td>139</td>
<td>90.8</td>
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<tr>
<td>Cocaine</td>
<td>9,708</td>
<td>14.9</td>
<td>447</td>
<td>4.6</td>
<td>447</td>
<td>0.7</td>
<td>435</td>
<td>97.3</td>
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<td>Methadone</td>
<td>4,549</td>
<td>7.0</td>
<td>2,351</td>
<td>51.7</td>
<td>2,351</td>
<td>3.6</td>
<td>2,293</td>
<td>97.5</td>
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<tr>
<td>Opiates</td>
<td>9,715</td>
<td>14.9</td>
<td>639</td>
<td>6.6</td>
<td>639</td>
<td>1.0</td>
<td>451</td>
<td>70.6</td>
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<tr>
<td>Propoxyphene</td>
<td>5,154</td>
<td>7.9</td>
<td>77</td>
<td>1.5</td>
<td>77</td>
<td>0.1</td>
<td>61</td>
<td>79.2</td>
</tr>
<tr>
<td>Total</td>
<td>59,835</td>
<td>91.8</td>
<td>5,331</td>
<td>8.9</td>
<td>5,331</td>
<td>8.2</td>
<td>4,751</td>
<td>89.1</td>
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panel based on the low screen positive rate (1.9%); (f) methadone should be excluded from the standardized panel based on the low screen positive rate (2.1%) for patients who were not at the methadone clinic; (g) propoxyphene should be excluded from the standardized DAU panel based on the low screen positive rate (1.5%) and (h) a sitespecific methadone DAU panel should be offered for patients in the methadone program.

In addition, the laboratory further recommended that the policy of confirmation of screened positive DAU tests by request only be implemented by all medical centers. Screened positive DAU tests would be held for 7 days pending a specific confirmation request to allow sufficient time for the care provider to decide whether DAU confirmation was needed. An electronic mail group was created to facilitate confirmation requests and enable the laboratory to document and track such requests.

Approval of the clinical staff and of the medical executive board at each site was obtained for all of the laboratory recommendations, except that the medical staff recommended that, based on clinical need, the laboratory offer cannabinoids in a second DAU panel. The following DAU panels were standardized: DAU 1 (benzodiazepines, opiates, cocaine); DAU 2 (benzodiazepines, opiates, cocaine, cannabinoids); and DAU-M (methadone, benzodiazepines, opiates, cocaine, as a site-specific DAU panel for the methadone clinic). The policy of confirmation of screened positive DAU tests by request only was adopted by all medical centers. A 6-mo follow-up study (January to June 2001) was then performed to evaluate the impact on DAU utilization and costs of standardizing the DAU panels and implementing the confirmation by request only policy.

Table 2 summarizes the findings for DAU screening test utilization and costs before and after standardization. Before standardization of DAU screening panels, there were a total of 59,835 DAU screening tests done at a cost of $216,005. After DAU panel standardization, there was decrease of 47% in total screen requests (27,876) and in DAU screening costs ($100,633). After standardization, there were significantly fewer requests with corresponding cost savings for individual DAU drugs not included in any DAU screening or site-specific panel: these DAU included barbiturates (-97%), amphetamines (-96%), propoxyphene (-94%), cannabinoids (-52%), and methadone (-35%).

Table 2 shows that the policy for confirmation of a positive DAU screened test by request only had a significant impact on utilization and costs of DAU confirmation testing. Before institution of the confirmation by request only policy, there were a total of 5,331 DAU confirmation tests done at a

<table>
<thead>
<tr>
<th>Drugs assayed</th>
<th>DAU screening tests</th>
<th>DAU confirmatory tests</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Beforea</td>
<td>Afterb</td>
</tr>
<tr>
<td>Amphetamines</td>
<td>5,827 ($21,035)</td>
<td>218 ($787)</td>
</tr>
<tr>
<td>Barbiturates</td>
<td>7,191 ($25,960)</td>
<td>226 ($816)</td>
</tr>
<tr>
<td>Benzodiazepines</td>
<td>9,721 ($35,093)</td>
<td>8,146 ($29,407)</td>
</tr>
<tr>
<td>Cannabinoids</td>
<td>7,970 ($28,772)</td>
<td>3,808 ($13,747)</td>
</tr>
<tr>
<td>Cocaine</td>
<td>9,708 ($35,046)</td>
<td>8,133 ($29,360)</td>
</tr>
<tr>
<td>Methadone</td>
<td>4,549 ($16,422)</td>
<td>2,978 ($10,751)</td>
</tr>
<tr>
<td>Opiates</td>
<td>9,715 ($35,071)</td>
<td>8,138 ($29,378)</td>
</tr>
<tr>
<td>Propoxyphene</td>
<td>5,154 ($18,606)</td>
<td>312 ($1,126)</td>
</tr>
<tr>
<td>Total</td>
<td>59,835 ($216,005)</td>
<td>31,959 ($115,372)</td>
</tr>
</tbody>
</table>

a Data for the period from January to June 2000
b Data for the period from January to June 2001
cost of $111,502. After institution of the uniform confirmation policy, there was 95% decrease in the total DAU confirmation requests (5,080) and costs ($105,826). There were dramatic decreases in DAU confirmation requests and costs for all DAU including 100% decrease for methadone and propoxyphene, 99% decrease for amphetamines, 94% decrease for barbiturates and benzodiazepines, 90% decrease for cannabinoids, and 88% and 87% decreases for cocaine and opiates, respectively.

Methadone confirmation testing, the costliest DAU before standardization, primarily because of the 5-fold cost differential between the DAU screening and confirmation tests, showed the greatest cost savings. Before standardization, 59% of the total methadone requests were received from the methadone clinic, but after standardization, the number of methadone screen requests from the methadone clinic increased to 86% of the total methadone screen requests. After standardization, methadone confirmation tests showed the greatest cost savings ($45,468), since requests for methadone confirmation decreased to zero.

**Discussion**

DAU panel standardization helped to clarify the confusing site-specific DAU panels that were available at the onset of this study. The wide range of available DAU panels, perhaps initially instituted for laboratory convenience in grouping individual drugs, may have unintentionally contributed to confusion and may have led to over-utilization and ordering of unnecessary drug tests, especially given the ease of ordering a panel with 8 tests when perhaps a panel of only 3 tests was indicated.

Following review of the clinical needs of our underlying population, DAU patterns that differ significantly from other populations, different environments (urban or rural) or other geographical areas [3,4], test ordering frequencies, and positive rates for several screening panels and the associated confirmation tests, we introduced changes in the DAU screening panels. Most important, the DAU panel standardization changes were all reviewed and approved by the clinician users at each institution before the changes were implemented.

The decision to exclude amphetamines from the standardized DAU panels was based on the zero confirmation rate for the screened positive amphetamines. A recent study reported that 91% of false positive immunoassay screening results, not confirmed by follow-up gas chromatography, were false positives results for amphetamines [5]. The false positive screen results for amphetamines can be attributed to the relative non-specificity of the amphetamine immunoassay, with cross-reactivity of the EMIT assay to a number of other phenylethylamine drugs (eg, ephedrine, pseudoephedrine, and phenylpropanolamine present in over-the-counter cold and decongestant medications) [6]. Other drugs that may cross-react and cause false positive amphetamine screen results include benzphetamine, phenmetrazine, phentermine, mephentermine, chlorpromazine, and promethazine [7,8].

For centers that perform employee drug screening, and random testing of prisoners, arrestees, parolees and athletes [9], it is doubtful that clinicians would accept the concept of not automatically confirming screen-positive DAU results because of the serious consequences of a positive DAU finding. In our population of patients in drug rehabilitation and treatment programs, where the primary purpose of DAU testing is to verify drug use and to monitor treatment progress, clinicians accept the concept of DAU screening without confirmation because they do not need the level of certainty provided by a confirmatory DAU test. Overall, clinicians are pleased with the rapid turn-around time for DAU screening results and find it useful to have this information, enabling them to confront the patient with a positive result, often leading to patient admission of drug abuse without a need for further confirmatory testing.

The provision to hold urine specimens for 7 days helped to convince the medical staff that there would be sufficient time to decide whether a confirmatory test was needed. For many facilities, especially those with high volumes of DAU testing, long-term storage of urine could introduce additional costs. However, we found that in our laboratory the storage was not a problem, because we discarded all negative screened DAU specimens and saved only the positive DAU screened specimens, which amounted
to approximately 200 specimens per week before the confirm by request only policy was implemented.

The concept of using DAU screening with no confirmation was evaluated in a recent study in a university medical center, which compared the usefulness of limited toxicology screening (enzyme immunoassay for 6 drugs) to comprehensive toxicology screening with thin-layer chromatography and gas-liquid chromatography in 1,734 consecutive cases [5]. This study showed 71% concordance between the results of limited and comprehensive toxicological screening [5]; the study suggested that the limited toxicology screen may be satisfactory for screening patients for drug use, that it should not be used for forensic purposes, and that screening may have advantages in more rapid turnaround time, 24-hr availability, and lower cost [5]. In our study, physician reaction to the confirmation by request only policy was favorable. The most frequent need for confirmation of DAU-positive screening results was in instances of a positive screening test result and patient denial of drug usage, a finding that is similar to other studies [10,11].

Methadone confirmation testing was the costliest DAU before standardization, primarily because the cost differential between a DAU screening and confirmation test was approximately 5-fold. After standardization, methadone confirmation test costs decreased dramatically with the number of methadone confirmation requests diminishing to zero. A 1990 survey of 324 methadone clinics nationwide found that the practice of confirming methadone results occurred in 69% of methadone clinics, while the remaining clinics provided screening with no routine follow-up confirmation [12].

Our study demonstrated that standardization of DAU panels and implementation of a policy of confirmation of positive DAU screen tests by request only can have a significant impact on DAU utilization and costs. These two policies have resulted in increased clinician satisfaction with the rapid turnaround time for DAU screening results without eliminating the clinical ability of ordering a DAU confirmation test if needed. We suggest that DAU panel standardization and institution of a DAU confirmation by request only policy, which have resulted in substantial decreases in DAU utilization and costs in a veterans population, could be a model for other populations with perhaps similar outcomes.

References