



Clinical value of drugs of abuse point of care testing in an emergency department setting



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ABSTRACT

Objective: Toxicology screening tests for drugs-of-abuse and therapeutic drugs in urine (TST-U) are often used to assess whether a patient's clinical condition can be explained by the use of drugs-of-abuse (DOA) and/or therapeutic drugs. TST-U have clinical value when they support clinical decision making by influencing diagnosis and patient care. We aim to quantify the influence of TST-U results on diagnosis and patient care in an emergency department. Our secondary objective is to identify specific patients for which a TST-U is most warranted or mostly unhelpful.

Methods: This prospective observational study was performed at the emergency department of a middle-sized urban teaching hospital. A point of care TST-U has been used in this department for three years. When a TST-U is considered indicated by a physician, the influence of the TST-U result on diagnosis and patient care is quantified before and after the test results are available, by means of a questionnaire. Urgency and complaints upon admission have also been registered.

Results: Of 100 TST-U results 37% were reported having a substantial influence on diagnosis and 25% on patient care. TST-U had a substantial influence on diagnosis in 48% of patients with decreased consciousness, 47% of patients with psychiatric symptoms and in 47% of patients with "other" complaints. In this last category patients with neurological symptoms benefited most. In patients who were already suspected to be intoxicated, only 18% of the TST-U results had substantial influence on diagnosis.

Conclusions: The use of point of care TST-U in an Emergency Department helps physicians to understand the clinical condition of a patient. They influence the way a patient is treated to a lesser extent. These tests are most helpful in patients with decreased consciousness, psychiatric or neurological symptoms and mostly unhelpful in patients who, upon admission, are already known to be intoxicated.

1. Introduction

1.1. Background

For adequate diagnosis and treatment in an acute setting, such as an Emergency Department, it is often important to know if the patient's clinical condition can be explained by effects of drugs-of-abuse (DOA) or therapeutic drugs. Comprehensive toxicology screening may detect drugs of abuse and therapeutic drugs in various biological specimens. Towards this end, various toxicology screening methods have been developed in different biological matrices, including blood, urine, hair and oral fluid. These screenings methods include immunoassays and chromatography assays, requiring specific and often time-consuming specimen treatments. Further, in an Emergency Department setting the choice and feasibility of sampling may depend on the clinical condition of the patient [1–10].

In most hospitals in the Netherlands, toxicology screening of drugs of abuse and therapeutic drugs in blood or urine takes place in central laboratories. Toxicology screening in central laboratories can be quite time-consuming and expensive, depending on laboratory techniques and trained personnel. Also, transportation issues and laboratory procedures may delay patient management and treatment, especially outside the office hours. A reliable bedside test for screening patients for drugs of abuse and therapeutic drugs, with an easy test protocol and instantaneous result, is often desired in the ED. There are many on-site testing devices (also called point-of-care tests) for drugs of abuse and therapeutic drugs that are commercially available [11–16]. Urine is by far the most widely used biological matrix for this purpose. Point-of-care tests currently available are based on competitive binding immunoassay to qualitatively determine the presence of drugs, and do not require difficult specimen treatment or sophisticated instrumentation. Results are generally available within 5–10 min. Most point-of-care

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tests have a multiple drug panel. When applied in a laboratory setting, many of these devices, especially those developed in the past decade, have been shown to produce reliable results [11–16]. Therefore we introduced point-of-care toxicology screening tests in urine (TST-U) for a number of frequently encountered DOA and therapeutic drugs to our emergency department [16].

1.2. Importance

Since the introduction of point-of-care TST-U to our emergency department (three years ago) these tests are frequently used (approximately 20 each month). Though the costs per test are relatively low, it is important to know whether TST-U have clinical value and if they can be used more effectively. For a TST-U to have clinical value, it should support clinical decision making by influencing diagnosis and patient care.

Several studies have been performed to assess the clinical value of TST-U in the emergency department, with contradicting results. Some researchers state that they have diagnostic value, are effective, less costly than conventional tests, decrease turnaround time and length of stay [17–19]. Other studies conclude that urine drug screening rarely influences patient care, does not improve clinical management, could be expensive and potentially inaccurate [15,20,21]. Only one study prospectively evaluated the effect of TST-U on patient care in the emergency department. In this study the test was performed by a central laboratory. Physicians were interviewed by an investigator before and after revealing the test results. They concluded that TST-U are rarely helpful in guiding patient care decisions in the emergency department, but did not investigate the diagnostic value [21].

1.3. Goals of this investigation

In this study we aim to quantify the diagnostic value of TST-U results and their influence on patient care. Our secondary objective is to identify specific patients for which a TST-U is most warranted or mostly unhelpful.

2. Materials and methods

2.1. Study design and setting

This study was designed as a non-comparative, prospective, observational study. No interventions were made. In cases where a physician ordered a TST-U to be conducted, he/she specified the influence of the test result on diagnosis and patient care after the result is revealed. The study procedure is shown in Fig. 1.

The study was performed at the Emergency Department (ED) of the Onze Lieve Vrouwe Gasthuis (OLVG) in Amsterdam, the Netherlands. The OLVG is a middle-sized (555 bed) urban teaching hospital, located in inner Amsterdam. With more than 50.000 patients annually, the

emergency department of the OLVG is the largest Emergency Department in the Netherlands. Physicians are often confronted with patients that are suspected of drug abuse and/or overdose.

2.2. Selection of participants

Annually approximately 50,000 patients visit the ED of the OLVG. TST-U are ordered in approximately 0.5% of all ED-presenting patients. All patients admitted to the emergency department, for whom a TST-U were considered by the physician were eligible for inclusion into the study. Every single patient has been included only once per hospital visit. All ED-physicians were trained in certified acute care and toxicology courses by means of continuing professional education. In addition, all ED physicians were trained on the job by the investigators on the potentials and limitations of TST-U and how to interpret the TST-U results.

This study was approved by the Medical Ethics Committee of the Onze Lieve Vrouwe Gasthuis, Amsterdam. During this study the TST-U were applied as in routine clinical practice. Patients were not treated differently or asked to do anything different than in cases of routine clinical practice. Therefore informed consent was not required.

2.3. Point-of-care-testing (TST-U)

Toxicology screening was performed using the Triage® TOX Drug Screen (Biosite Diagnostics, San Diego, U.S.A.). This competitive fluorescence immunoassay can be used to determine the presence of DOA and a panel of therapeutic drugs in urine. The drug panel consists of amphetamine, methamphetamine, barbiturates, benzodiazepines, cocaine, methadone, phencyclidine, opiates, tetrahydrocannabinol (THC, the main active component of cannabis), and tricyclic antidepressants. Tests were performed on-site by emergency department nurses. Users were periodically trained by laboratory technicians of the Department of Clinical Pharmacy. A test yielded a positive result in case the amount of drug in urine exceeded a certain threshold. Results were available within 10 min. The interpretation of the results was non-subjective, because the test results were not visibly read but measured by the Triage Reader. Sensitivity and specificity for each of the measured compounds is high. The device has built-in quality controls and is capable of electronic record keeping [16].

Routinely, ED physicians orders TST-U in cases of suspected intoxications. The ED nurse labels a urine container with the specific patient data. The ED physician or nurse collects urine from the patient. The ED nurse performs the test as described earlier [16]. For this study purpose, the ED nurse handed a questionnaire to the physician before the test was performed. The physician registered the initial differential diagnosis and intended treatment. The nurse performed the test. Also, the nurse verified whether differential diagnosis and intended treatment had been specified. Thereafter, the nurse revealed the TST-U result to the physician. Then, the physician specified the differential

- 1 TST-U is ordered by the physician
- 2 Nurse hands a questionnaire to the physician
- 3 Physician specifies the initial differential diagnosis and intended treatment
- 4 Nurse performs the test
- 5 Nurse verifies initial differential diagnosis and intended treatment are specified
- 6 Nurse reveals the TST-U result
- 7 Physician specifies differential diagnosis and intended treatment considering the TST-U result
- 8 Physician specifies the influence of the TST-U result on diagnosis and patient care using a 5 point scale

Fig. 1. Study procedure.

Diagnosis: The TST-U

- D1 provided false information and led to extra (unnecessary) investigations
- D2 did not provide relevant diagnostic information
- D3 confirmed what I already thought
- D4 contributed to my diagnostic understanding, but other factors were more important
- D5 was the most important factor in diagnosis

Patient care: The TST-U

- P1 led me to choose a treatment which was not the best choice for the patient at that time
- P2 did not influence my choice of treatment
- P3 did not alter my choice of treatment, but reassured me that I made the right choice
- P4 influenced my choice of treatment, but other factors were more important
- P5 was the most important factor in choosing a treatment

diagnosis and intended treatment considering the TST-U result and the influence of the TST-U result on diagnosis and patient care (see also Fig. 1).

The influence of TST-U testing on diagnosis and patient care was quantified using a 5-point scale (Fig. 2). Since the influence of TST-U on diagnosis as well as patient management in an emergency care setting has not been quantified before, no validated questionnaire was available to quantify these parameters. Therefore we adjusted a diagnostic value questionnaire, which was used in three studies assessing the clinical value of diagnostic imaging [22–24]. All TST-U results for which a score of 4 or 5 for either diagnosis or patient care was reported, were regarded as having a substantial influence.

To identify the patients for which a TST-U is most warranted or mostly unhelpful we gathered additional information from the Emergency Department electronic patient dossier (E.Care ED, Turnhout, Belgium). In this dossier the urgency of patients complaints upon arrival (as assessed by the triage nurse) are available. Urgency is classified using a five colour scale (least urgent to most urgent: blue, green, yellow, orange and red). The reason for admission and other patient characteristics necessary for our analysis (age, sex) are also available. During analysis the patients were categorised according to the reason for admission:

- Decreased, and loss of consciousness
- (Auto)-intoxication
- Trauma
- Psychiatric symptoms
- Other complaints

The category “Other complaints” contains patients with neurological, abdominal, infectious, cardiovascular and pulmonary symptoms, and sexual abuse.

Analyses were performed using SPSS for Windows, version 18.0 (Chicago IL.). The demographic data were described in median with interquartile range. Categorical data were described in frequencies and/or percentages. To compare the data concerning the primary objective non-parametric tests for related samples were used: Marginal Homogeneity and the McNemar test. The chi-square test was used to evaluate the relationship between level of urgency and the cases in which a substantial influence was reported. A p -value $\ll 0.05$ was

Fig. 2. Scales used to assess the influence on diagnosis and patient care (according to ref 18).

considered statistically significant.

3. Results

3.1. Characteristics of study subjects

Data were collected between June 15, 2011 and April 10, 2012. During this period a total of 180 TST-U were used. Only 100 TST-U could be included for the analysis of our primary and secondary objectives (Fig. 3). Main reasons for exclusion were:

- The questionnaire was not completely filled out (46 tests, 26%)
- The test did not produce a valid result since it was used erroneously (28 tests, 16%).
- The test was used for educational purposes (6 tests, 3%)

The two main reasons of failure of the test were: 1) the use of cold TST-U strips (stored refrigerated); in these cases the antibody reactions of the test were inadequate en the TST-U device gave no valid result; 2) the use of insufficient amounts of urine. During the study we reduced the occurrence of errors by providing additional training for the nursing staff. All tests for which the questionnaire was not completely filled out, were evaluated to assess possible bias. No specific circumstance, group of patients or physicians could be identified as the main reason for not completely filling out the questionnaire, so no intervention could be done to improve this. We suspect that the hectic environment, in which the questionnaires were filled out, was the primary reason.

The data for the included patients are shown in Table 1. The majority of the patients that were tested were male (75 versus 25%). Males were generally older than females (median age 38 versus 23 years). Benzodiazepines and tetrahydrocannabinol (THC) were the most frequently found drugs.

3.2. Main results

Our primary objective was to quantify the influence of TST-U on diagnosis and patient care. Fig. 4 shows the frequencies of the scores (see Fig. 2) that were reported.

The distribution of scores for the influence on diagnosis and patient care differ significantly ($p = 0.000$), indicating that TST-U test results

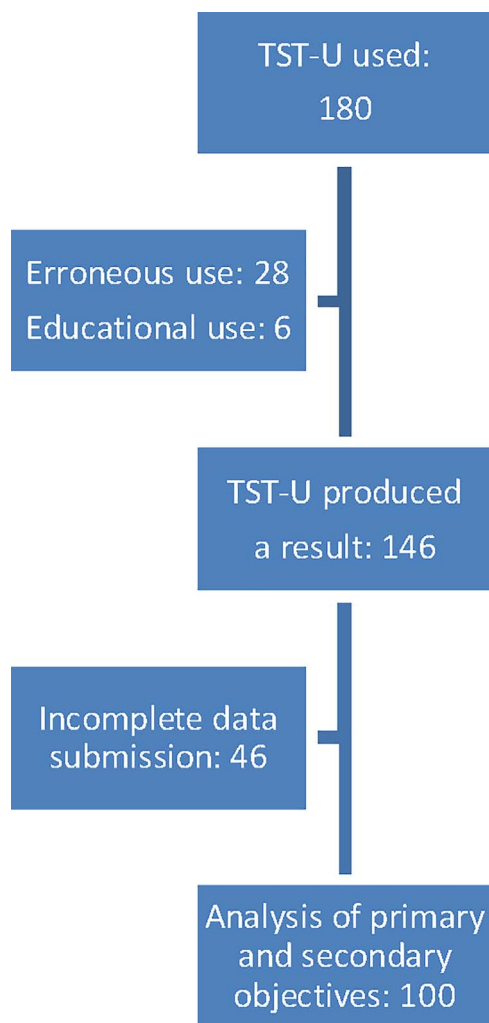


Fig. 3. Inclusion.

Table 1
Demographic data for the TST-U that produced a result.

| | | Male | Female |
|-----------------------------------|---------------------------|------|--------|
| Number of patients tested | | 75 | 25 |
| Median age | | 38 | 23 |
| Number of drugs tested positively | 0 | 22 | 10 |
| | 1 | 24 | 7 |
| | 2 | 22 | 5 |
| | 3 | 5 | 2 |
| | 4 | 0 | 1 |
| | 5 | 2 | 0 |
| Drug tested positively | Amphetamines | 1 | 0 |
| | Methamphetamines | 8 | 1 |
| | Barbiturates | 1 | 0 |
| | Benzodiazepines | 28 | 10 |
| | Cocaine | 14 | 2 |
| | Methadone | 5 | 2 |
| | Opiates | 10 | 2 |
| | Phencyclidine | 0 | 0 |
| | Tetrahydrocannabinol | 25 | 9 |
| | Tricyclic antidepressants | 1 | 1 |

have a different influence on diagnosis compared to patient care. Of all TST-U results 37% were reported having a substantial influence on diagnosis (D4 + D5), 25% had a substantial influence on patient care (P4 + P5). These two groups also differ significantly ($p = 0.023$).

Our secondary objective was to identify specific patients for which a TST-U is most warranted or mostly unhelpful. The majority of TST-U

were used for patients that had an urgent condition (see Table 2). TST-U that were reported having a substantial influence were equally divided amongst the five groups. No relationship was found between the level of urgency and the number of TST-U that were reported having a substantial influence on diagnosis and treatment ($p = 0.624$). Based on the urgency assessed by the triage nurse, we cannot say whether a TST-U will have a substantial influence on diagnosis and patient care.

The frequencies of patients regarding the reason for admission and the reported influence for these categories are also shown in Table 2. TST-U have most influence on diagnosis when they are used for patients with decreased and loss of consciousness (48%), psychiatric symptoms (47%) and other complaints (47%). In this last category 4 out of 5 TST-U performed in patients with neurological symptoms had a substantial influence on diagnosis. For patients with psychiatric symptoms 47% of the TST-U also had a substantial influence on patient care. TST-U have substantially less influence on diagnosis and patient care when they are used for patients with an (auto)-intoxication (18% and 7% respectively).

4. Discussion

In our study 37% of the TST-U results substantially helped the physician in diagnosis and 25% substantially influenced the way the patient was treated. Keeping in mind that TST-U are relatively inexpensive compared to other diagnostic tools such as MRI- or CT-scans, we conclude that they offer value for money. In earlier studies CT-scans substantially influenced diagnosis in respectively 41 and 52% of patients and substantially influenced treatment in 17 and 14% of patients [13,14]. These percentages are comparable to our findings.

A large percentage of the TST-U confirmed a suspected diagnosis (D3: 46%) or reassured physicians in making the right choice of treatment (B3: 27%). Though we did not consider this as a substantial influence, confirmation and reassurance is also valuable to physicians.

Our emergency care physicians have a lot of experience with intoxicated patients and use the TST-U selectively. Every year they see more than 1000 intoxications (not including mono-intoxications with alcohol). Our results show that the tests can be used even more selectively, because there are certain patient groups in which they rarely help diagnosis and/or influence treatment. This applies to patients who are already known to be intoxicated. Treatment for these patients will almost always be supportive, and TST-U should therefore not be used for them. This will also result in cost reduction (maximum of 28%) and more efficiency.

This study has strengths and limitations. The strength of this study is that clinical value measurements of tests give insight into how these drugs tests perform in real-life clinical practices and their performance in specific patient groups. This may result in better and more efficient drug testing in individual clinical settings and ultimately more efficient and effective treatment of acute care patients. It may also reduce costs by avoiding unnecessary drug testing.

The limitations of this study are the subjective nature of the outcome measurements and the inherent bias in the selection of subjects to undergo urine testing, resulting in variable pretest probability of positive and negative tests. For instance, physicians will only use the TST-U when they are uncertain about diagnosis and/or treatment. This may limit the external validity of our study to other clinical settings. In settings where physicians have less experience in treating intoxicated patients they may use the TST-U more often and rely more heavily on the TST-U result. Our results can therefore only be extrapolated to similar emergency departments. Also, we believe that the hectic environment could be the main reason for not completely filling out a questionnaire. This may have led to report bias due to under-representation of patients with a high level of urgency and could be an explanation for not finding a relationship between the level of urgency and the number of TST-U that were reported having a substantial influence on diagnosis and treatment.

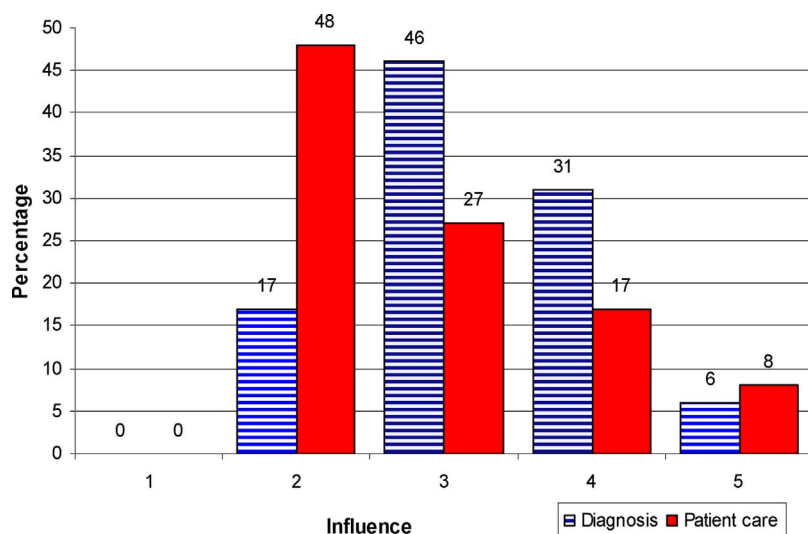


Fig. 4. The influence of TST-U on diagnosis and patient care. A higher score means that the TST-U had more influence on diagnosis or patient care. See Fig. 2 for an explanation of the scales.

Table 2

Frequencies of drug testing in patients according to urgency and the reason for admission, with the number of times a substantial influence on either diagnosis or patient care was reported.

| Urgency | Frequency | Substantial influence on diagnosis (D4 + D5) (%) | | Substantial influence on patient care (P4 + P5) (%) | |
|--------------------------------------|-----------|--|------|---|------|
| Blue (least urgent) | 4 | 0 | (0) | 1 | (25) |
| Green | 8 | 3 | (38) | 3 | (38) |
| Yellow | 26 | 13 | (50) | 8 | (31) |
| Orange | 49 | 17 | (35) | 9 | (18) |
| Red (most urgent) | 13 | 4 | (31) | 4 | (31) |
| Reason for admission | | | | | |
| Decreased, and loss of consciousness | 27 | 13 | (48) | 8 | (30) |
| (Auto)-intoxication | 28 | 5 | (18) | 2 | (7) |
| Trauma | 11 | 3 | (27) | 4 | (36) |
| Psychiatric symptoms | 15 | 7 | (47) | 7 | (47) |
| Other complaints | 19 | 9 | (47) | 4 | (21) |

When we review the literature about the clinical value of TST-U, we can roughly distinguish two groups of physicians. One group of physicians is not convinced that TST-U have much added value, and will rarely use them [15,20,21,25–32]. The other group finds TST-U a useful diagnostic tool, because they provide confirmation and/or reassurance [17–19,33–37].

5. Conclusion

Toxicology screening tests for DOA and therapeutic drugs in urine in the emergency department often help diagnosis and affect patient care to a lesser extent. Every ED should decide whether TST-U could be a useful diagnostic tool. As mentioned above, this can differ from one ED to another and even from one physician to another. Based upon our results, we decided that the TST-U have sufficient diagnostic value to continue the use in our ED. We intensified the training of our ED staff to reduce erroneous use and are working on protocols to make the use of TST-U more efficient.

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