Different Rapid Screening Strategies for Drugs of Abuse in the Clinical Setting

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1. Introduction:

Screening for drugs of abuse (DOA) has an important role in patient management in both the acute hospital setting and in community substance misuse services.[1,2] Whilst mass spectrometry remains the gold standard for testing, it can be challenging to deliver results rapidly and this may affect the utility of the results in urgent clinical scenarios.

The aim of this work was to evaluate the accuracy and cost-effectiveness of different rapid testing strategies for DOA in urine to explore the feasibility of introducing a rapid test for urgent care. The results may be useful to laboratories wishing to implement frontline mass spectrometry analysis but provide rapid results in urgent cases.

2. Methods:

The accuracy of two different rapid screening approaches (Randox Evidence Multi-STAT and Matrix 8 panel cups) was evaluated in a four-way method comparison with immunoassay (Roche c702) and liquid-chromatography tandem mass spectrometry (LC-MS/MS) for 44 patient urine samples. Performance (sensitivity, specificity, false positive and false negative rates) was assessed against the manufacturers' cut-offs and the European Workplace Drug Testing (EWDT)[3] cut-offs for seven drugs/metabolites: opiates, 6-monoacetylmorphine, amphetamine, methadone, cocaine metabolite, benzodiazepines and cannabis. A cost-benefit analysis was performed based on kit cost, staff time and estimated sample volumes.

3. Results:

No significant difference was found between the proportion of positive and negative results obtained using each of the three screening tests (p=0.1572). The overall false negative rates (average 2.7%) and false positive rates (average 5.3%) were similar across all methods (table 1).

Table 1. Analytical performance of each screening method across multiple analytes.
95% confidence intervals given in brackets. False negative / false positive rates shown are calculated according to EWDT cut-offs.[3]

Method	False positive rate	False negative rate	Sensitivity	Specificity
Matrix 8 panel cups	2.7% (1.0% - 6.6%)	3.5% (1.4% - 8.8%)	98.9% (93.8% - 99.8%)	93.2% (97.6 – 96.4%)
Randox Evidence Multi-STAT	6.6% (3.6% - 11.8%)	2.9% (0.9% - 7.5%)	96.4% (91.2% - 98.6%)	93.4% (88.2 – 96.4%)
Roche c702 immunoassay	6.6% (3.6% - 11.8%)	1.8% (0.5% - 6.2%)	99.1% (95.1% - 99.8%)	93.5% (88.4% - 96.4%)

The Randox Multi-STAT assay for cocaine metabolite was the only analyte to demonstrate significantly different results to the LC-MS/MS (p=0.0313). The overall clinical efficiency of the three screening methods was found to be 96.4% (93.0 – 98.1%) for the Matrix 8 panel cups, 95.1% (91.7 – 97.1%) for the Randox Multi-STAT and 95.5% (92.2 – 97.4%) for the Roche c702.

Implementing a testing strategy involving frontline LC-MS/MS for routine samples with a rapid testing device for emergency care could generate a cost saving of 27% over current immunoassay screening methods (table 2).

Table 2. Estimated cost per annum for the current testing strategy in the Hull-York region compared with that of the cheapest alternative strategy.

Testing strategy	Estimated cost per annum*
Current: Roche c702 analysis for all samples with LC-MS/MS confirmation for positive opiate/amphetamine results.	£29,855.76
Cheapest: Frontline LC-MS/MS analysis for all routine samples with Matrix 8 panel cups for acute scenarios (followed by LC-MS for confirmation of positive opiate and amphetamine results only)	£21,936.73

4. Summary & Conclusions:

- Despite discrepancies with the manufacturer's performance claims, these modern rapid testing devices perform as well as immunoassay methods.
- Further work is required to evaluate the effectiveness of the devices outside the laboratory setting.
- **The Matrix 8 panel cups may be a cost-effective addition to DOA screening strategies employing frontline LC-MS/MS in order to provide rapid results in urgent clinical scenarios.**

5. References:

1. Lager PS, Attema-de Jonge ME, Gorzeman MP, et al. Clinical value of drugs of abuse point of care testing in an emergency department setting. *Toxicol Reports* 2018; 5:12–17.
2. Medical Advisory Secretariat. Optimum methadone compliance testing: an evidencebased analysis. *Ont Health Technol Assess Ser* 2006; 6: 1–54.
3. Taskinen S, Beck O, Bosch T, et al. European guidelines for workplace drug testing in urine. *Drug Test Anal* 2017; 9: 853–865.