RANDOX TOXICOLOGY

BIOCHIP ARRAY SCREENING OF BLOOD AND URINE SAMPLES FOR THE RECOMMENDED DRUGS ASSOCIATED WITH DRIVING UNDER THE INFLUENCE OF DRUGS (DUID)

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INTRODUCTION

Biochip array technology enables the simultaneous detection of multiple analytes from a single sample. As drug impaired driving is becoming a major problem in the US and worldwide, recommendations for the toxicological investigation of drug-impaired driving and motor vehicle fatalities were reported. These recommendations focused on a two-tier approach of drug analysis.

Tier 1 consisted of the most prevalent drugs found in the US impaired driving population and Tier 2 drugs being less frequently encountered, with regional significance and/or beyond the routine analytical capabilities of some laboratories.

Tier 1 drugs should be the minimum testing that should be completed in drug driving casework.[1] Recommended cut-offs have been stated suitable for the matrix of interest such as blood and urine.

This study reports the applicability of a biochip array to the simultaneous screening of Tier 1 and Tier 2 drugs in whole blood and a second biochip array suitable for urine. This leads to test consolidation and an increase in the screening capacity, which is relevant in test settings.

METHODOLOGY

- Competitive chemiluminescent biochip-based immunoassays were employed. Ligands were immobilized and stabilized to the biochip surface defining an array of twenty discrete test sites (15 Tier 1 assays and 5 Tier 2 assays). The signal output is inversely proportional to the concentration of drug in the sample.
- Two panels were developed so that the desired cut-offs were achieved in each matrix and that the relevant parent and metabolite compounds were detected in the whole blood and urine respectively.
- The assays are semi-quantitative and applicable to both the fully automated Evidence analyser and the semi-automated analyser Evidence Investigator. The systems have dedicated software to process, report and archive the data produced.
- The sample volume required is 60µl of whole blood (diluted 1 in 4) and 10 µl of neat urine.

Test Menu on DoA ULTRA Array

Tier 1		
Amphetamine	Cocaine metabolite (Benzoylecgonine)	Opiates
Barbiturates	Generic Opioids	Oxycodone 1
Benzodiazepine 1	Meprobamate	Oxycodone 2
Benzodiazepine 2	Methadone	Phencyclidine
Cannabinoids	Methamphetamine	Zolpidem

Tier 2	
Buprenorphine	Tramadol
Dextromethorphan	Tricyclic antidepressants (TCAs generic)
Fentanyl	

RESULTS

Application to blood (on Evidence Investigator)

Tier 1		
Assay	LOD (ng/mL) (neat sample)	Cut-off (ng/mL)
Amphetamine	5.97	20
Barbiturates	5.10	50
Benzodiazepine 1	0.07	10
Benzodiazepine 2	0.53	10
Cannabinoids	1.45	10
Cocaine metabolite (Benzoylecgonine)	1.27	50
Generic Opioids	0.84	10
Meprobamate	9.23	100
Methadone	0.13	10
Methamphetamine	5.74	20
Opiates	0.35	10
Oxycodone 1	1.02	10
Oxycodone 2	0.47	10
Phencyclidine	0.32	5
Zolpidem	0.07	10
Tier 2		
Assay	LOD (ng/mL) (neat sample)	Cut-off (ng/mL)
Buprenorphine	0.004	5
Dextromethorphan	0.01	5
Fentanyl	0.09	2
Tramadol	0.29	5
Tricyclic antidepressants (TCAs generic)	1.19	60

Precision

Intra-assay (n=20) and inter-assay precision (n=20) values, expressed as CV (%) were <20 for all the assays at different concentration levels.

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Application to urine (on Evidence Investigator)

Tier 1		
Assay	LOD (ng/mL)	Cut-off (ng/mL)
Amphetamine	51.2	200
Barbiturates	27.5	200
Benzodiazepine 1	0.4	100
Benzodiazepine 2	3.7	100
Cannabinoids	3.1	20
Cocaine metabolite (Benzoylecgonine)	4.8	150
Generic Opioids	7.2	100
Meprobamate	23.9	500
Methadone	5.5	300
Methamphetamine	12.6	200
Opiates	11.4	200
Oxycodone 1	5.1	100
Oxycodone 2	0.3	100
Phencyclidine	1.0	25
Zolpidem	1.1	10
Tier 2		
Assay	LOD (ng/mL)	Cut-off (ng/mL)
Buprenorphine metabolite	0.2	5
Dextromethorphan	0.8	20
Fentanyl	0.3	2
Tramadol	0.7	5
Tricyclic antidepressants (TCAs generic)	1.7	100

Precision

Intra-assay (n=20) and inter-assay precision (n=20) values, expressed as CV (%) were <20 for all the assays at different concentration levels.

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CONCLUSION

The results indicate applicability of biochip array technology to the simultaneous screening of drugs associated with DUID in Tier 1 and Tier 2 under reported recommendations. The twenty immunoassays arrayed on each biochip surface presented both the desired sensitivity and reproducibility required to achieve screening at the recommended cut-offs. This methodology allows for multi-analytical screening of blood and urine samples, leading to test consolidation and increased screening capacity in test settings.

Reference

[1] Logan, B.K. *et al.* Recommendations for toxicological investigation of drug-impaired driving and motor vehicle fatalities. *Journal of Analytical Toxicology* 2013:37(8):552-558.