K21 A 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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After attending this presentation, attendees will better understand the application of biochip array technology to the simultaneous screening of drugs associated with DUID. The goal of this presentation is to describe how matrix-specific tests can be developed to adhere to guidelines for both urine and blood.

This study will impact the forensic science community by providing the results of two biochip arrays that allow the simultaneous determination of drugs associated with DUID and included in Tier 1 and Tier 2 under reported recommendations. Twenty immunoassays arrayed on each biochip surface allow this multi-analytical screening from a single whole blood or urine sample. This leads to test consolidation and an increase in the screening capacity in test settings.

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 United States 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 United States 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.

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.

Tier 1 assays included were: Amphetamine (AMPH), Methamphetamine (MAMP), Barbiturate (BARB), Benzodiazepine Class 1 (BENZ1), Benzodiazepine Class 2 (BENZ2), Cannabinoids (THC), Cocaine/Benzoylecgonine (BZG), Hydromorphone (OPDS), Meprobamate (MPB), Methadone (MDONE), Opiates (OPIAT), Oxycodone (OXYC1 and OXYC2), Phencyclidine (PCP), and Zolpidem (ZOL). Tier 2 assays included: Buprenorphine (BUP), Dextromethorphan (DMP), Fentanyl (FENT), Tramadol (TRM), and Tricyclic antidepressants (TCAs). Two panels were developed so that the desired cut off 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 10µl of neat urine.

In this initial evaluation, the limit of detection was determined by running 20 negative urine samples and 20 negative blood samples. The resultant mean concentration +3STDEV was less than 50% of the cut off required. The cut off values were further validated by assessing inter assay precision. Blood and urine samples were spiked with the appropriate drug compound 50% below, at the cut off, and 50% above the recommended cut off. Three replicates were assessed over five separate runs and the inter assay precision calculated to be less than 20% for all assays across both blood and urine panels.

In 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 samples, leading to test consolidation and increased screening capacity in test settings.

Reference(s):

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.

DUID, Biochip Array, Tier 1