

Targeted Drug Screen Based on LC-MS/TOF

FOR DRUG SCREENING PERFORMED BY LIQUID CHROMATOGRAPHY COUPLED WITH TIME-OF-FLIGHT MASS SPECTROMETRY (LC-MS/TOF)

Test Highlights

- Qualitative identification of 53 drugs or drug metabolites.
- Specific identification does not require confirmatory testing unless quantitative results are needed, a second methodology is required, or if results are inconsistent with expectations.
- Quantitative confirmatory testing is ordered separately, if needed.

Clinical Background and Indications for Ordering

- Identification of drugs in serum or plasma is clinically useful to verify compliance with prescribed therapy and to identify inappropriate drug use. Serum or plasma is the best specimen for drug testing when the objective of drug testing is to:
 - Verify compliance with prescribed therapy (e.g., to support pain-management clinics), particularly for patients who cannot provide urine.
 - Correlate clinical signs and symptoms with exposure to a particular drug.
 - Verify drug absorption.
 - Evaluate individual pharmacokinetics.

Interpretation

- Positive drug screen:
 - The patient recently took or was otherwise exposed to a drug or a precursor drug (e.g., a prodrug) to the compound identified; the compound(s) reported could be drug metabolite(s).
 - The patient was exposed to more than one drug; the pattern of drugs and drug metabolites is important for predicting the original drug or drugs that a patient may have taken or otherwise been exposed to.
- Negative drug screen:
 - The drug or drugs of interest are not detected by the drug test ordered.
 - The patient did not take the drug or drugs expected.
 - The drug or drugs expected were not absorbed at the time of specimen collection or were eliminated prior to the time of specimen collection.

Limitations

- Identification of drugs or drug metabolites is dependent on time of specimen collection relative to time of drug administration, drug dose, drug formulation, genetic factors, clinical factors, co-administered drugs, and analytical factors.
- The targeted drug screen does not report drug concentrations; confirmatory testing must be ordered separately if drug concentrations are required.
- Timing of drug administration relative to specimen collection or amount of drug administered cannot be determined from a single blood specimen.

Methodology

- Liquid chromatography and time-of-flight mass spectrometry (LC-MS/TOF) is a highly sensitive and specific technology applied recently to qualitative drug screening.
 - Compounds are identified by comparing chromatographic retention time, mass, isotope spacing, and isotope abundance of the suspected positive to expected values.
 - LC-MS/TOF utilizes chromatographic separation combined with high-resolution accurate mass MS/TOF for qualitative compound identification.
 - Mass resolution on the order of 10,000 and accuracy in the milli-Dalton (mDA) range, or ± 0.001 amu, can be achieved.
 - LC-MS/TOF provides drug-screening results that are sufficiently specific, and reflex confirmatory testing is not usually required; LC-MS/TOF testing is therefore “targeted.”
 - LC-MS/TOF is more sensitive than many immunoassays, identifying drugs and drug metabolites at lower concentrations for some drug classes.
- The two choices for serum or plasma drug screens at ARUP are compared in the following table:

Traditional Screen (ARUP test #0092420) (immunoassay)		Targeted Screen (ARUP test #2003254) (LC-MS/TOF)	
DRUGS OR DRUG CLASSES DETECTED	CUTOFF (LIMIT OF DETECTION)	DRUG CLASSES, SPECIFIC DRUGS, AND DRUG METABOLITES DETECTED	CUTOFF (LIMIT OF DETECTION)
Opiates	30 ng/mL	Opioids	1–25 ng/mL
Oxycodone	30 ng/mL	Buprenorphine (buprenorphine glucuronide, norbuprenorphine, norbuprenorphine glucuronide); dodeine, dihydrocodeine, fentanyl, norfentanyl, 6-acetylmorphine (heroin metabolite), hydrocodone, hydromorphone, meperidine (normeperidine), methadone (EDDP), morphine, oxycodone, oxymorphone, propoxyphene (norpropoxyphene), tapentadol, tramadol (N-desmethyltramadol, O-desmethyltramadol)	
Methadone	40 ng/mL		
Propoxyphene	75 ng/mL		
STIMULANTS			
Cocaine	30 ng/mL	Cocaine (benzoylecgonine, cocaethylene, m-hydroxybenzoylecgonine), amphetamine, methamphetamine, MDMA (Ecstasy), MDEA (Eve), MDA	20 ng/mL
Amphetamines	30 ng/mL		
SEDATIVE-HYPNOTICS			
Benzodiazepines	75 ng/mL	Alprazolam (alpha-hydroxyalprazolam), clonazepam (7-aminoclonazepam), diazepam, flurazepam metabolites (desalkylflurazepam, 2-hydroxyethylflurazepam), lorazepam, midazolam, nordiazepam, oxazepam, temazepam, triazolam (alpha-hydroxytriazolam)	25 ng/mL
Barbiturates	75 ng/mL	Amobarbital, butalbital, pentobarbital, phenobarbital, secobarbital	500 ng/mL
OTHER			
Marijuana	30 ng/mL	Marijuana (11-nor-9-carboxy-THC)	60 ng/mL
Phencyclidine	15 ng/mL	Phencyclidine	10 ng/mL

Related tests

- Traditional immunoassay-based drug screen with reflexed confirmation testing (0092420).
- Individual tests designed to support therapeutic drug monitoring applications are available through www.aruplab.com.
- Several urine-based drug-monitoring screens, confirmatory tests, and panels are available through www.aruplab.com.
- For more information about clinical applications of drug testing and specifications of drug-confirmation tests offered through ARUP Laboratories, see <http://www.arupconsult.com/Topics/DrugTesting.html> and <http://www.aruplab.com/Lab-Tests/resources/da-plasma-urine.pdf>.

References

1. Lynch KL, et al. Performance evaluation of three liquid chromatography mass spectrometry methods for broad spectrum drug screening. *Clin Chim Acta* 2010;411(19–20):1474–81.
2. Gingras M, Laberge MH, Lefebvre M. Evaluation of the usefulness of an oxycodone immunoassay in combination with a traditional opiate immunoassay for the screening of opiates in urine. *J Anal Toxicol* 2010;34(2):78–83.
3. Nielsen MK, et al. Simultaneous screening and quantification of 52 common pharmaceuticals and drugs of abuse in hair using UPLC-TOF-MS. *Forensic Sci Int* 2010;196(1–3):85–92.

Test Information

2003254

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For specific collection, transport, and testing information, refer to the ARUP website at www.aruplab.com.

For information on test selection, ordering, and interpretation, refer to ARUP Consult® at www.arupconsult.com.