

If Baby Could Talk: Laboratory Detection of Prenatal Drug Exposure

Gwen McMillin, PhD. DABCC (CC,TC)

Medical Director, Toxicology and Pharmacogenomics
ARUP Laboratories

Professor (Clinical), Department of Pathology
University of Utah School of Medicine

July 29, 2015

Illicit drug use while pregnant

- 5.9% of all ages
- 18.3% age 15-17
- 9.0% age 18-25
- 3.4% age 26-44



2012 SAMHSA National Survey on Drug Use and Health, NSDUH Series H-46, HHS Publication 13-4795, Rockville, MD, USA

What about
prescription drug use
and misuse?

**A baby's life shouldn't
begin with detox**

www.BornDrugFreeFL.com
1-877-233-5656



The number of infants diagnosed with neonatal abstinence syndrome (NAS) has increased >10-fold since 1995. Between 2010-11

- 99.6% tested positive for opioid exposure
- 97.1% admitted to intensive care units; average stay was 26.1 days
- <1% were documented to use heroin



**AN ESTIMATED 10-11% OF ALL
BIRTHS IN THE USA ARE
AFFECTED BY PRENATAL DRUG
EXPOSURE**

<http://www.ncsacw.samhsa.gov/resources/substance-exposed-infants.aspx>

Drugs in Pregnancy – *what it means for baby*

- Premature birth
- Low birth weight
- Withdrawal symptoms (e.g., NAS)
- Feeding issues / failure to thrive
- Developmental delays
- Behavioral problems
- Neglect
- Increased risk of drug abuse later in life

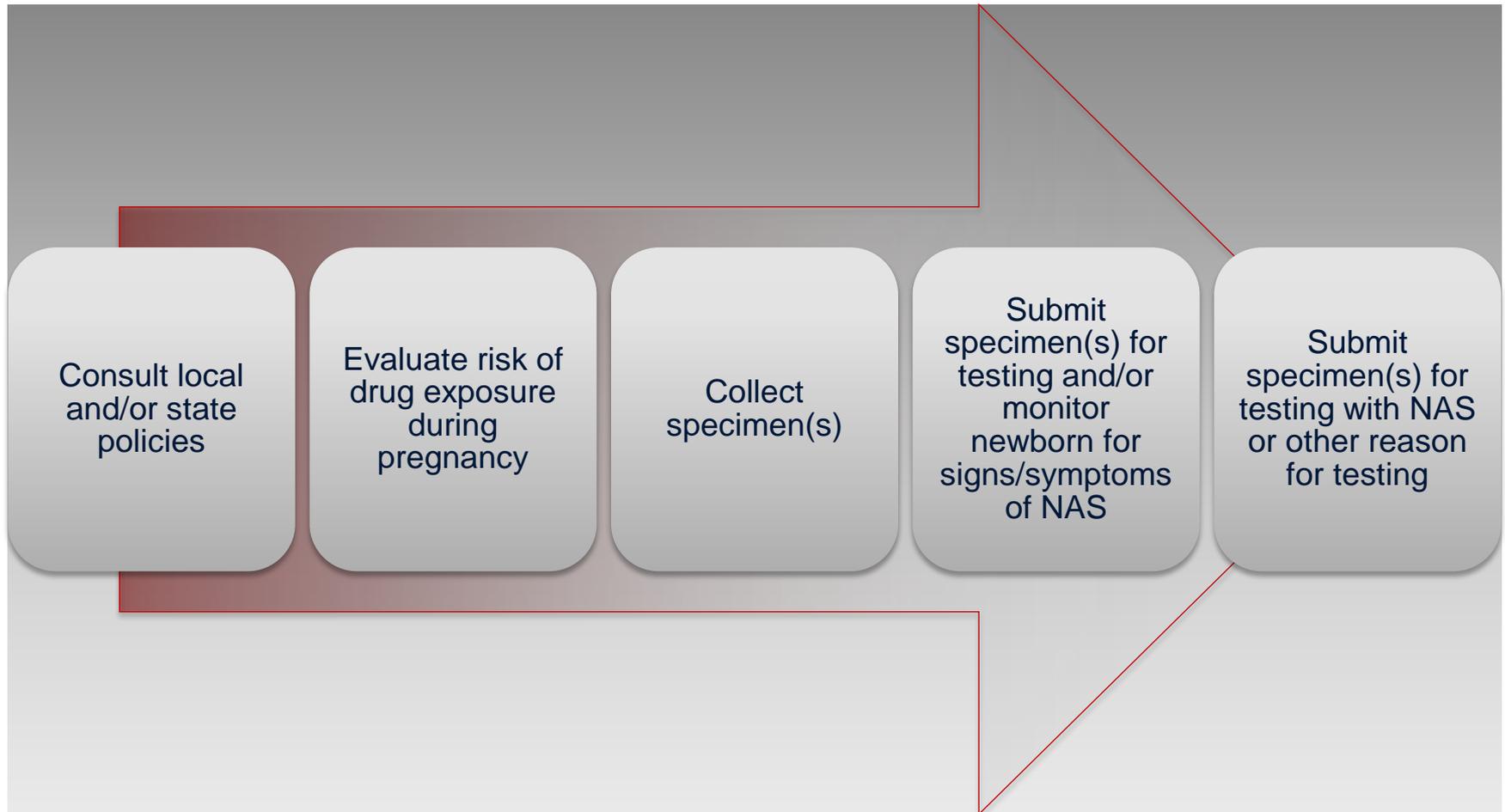


How to detect prenatal drug exposure?

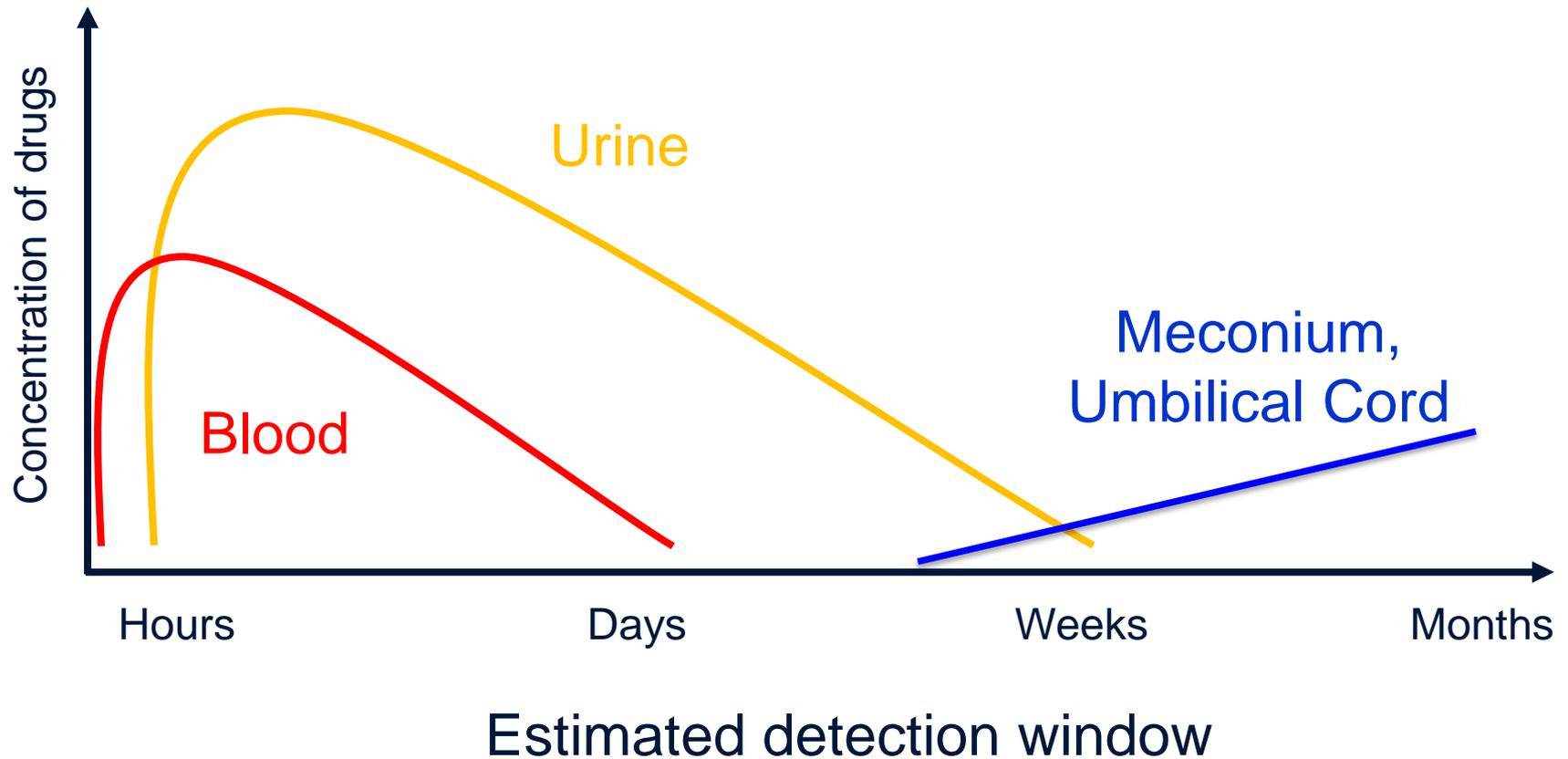
- Maternal self-report
 - Unreliable and under-estimates use
- Maternal testing
 - Serial, comprehensive testing is not practical or cost-effective for most
 - Does not prove that baby was exposed (or not)
- Maternal screening to evaluate risk of exposure
- Newborn testing



Approach to detect drug-exposed newborns



Specimens for drug detection



Meconium

- First stool of the newborn
- Used for drug testing for ~25 yrs
- Begins to form at ~12-16 wks gestation
- Accumulates over remainder of pregnancy
- Largest quantity accumulates in late pregnancy
- Usually passes within 48 hours of birth
- Looks different than milk stool
- Collection requires coordinated efforts and may not be available

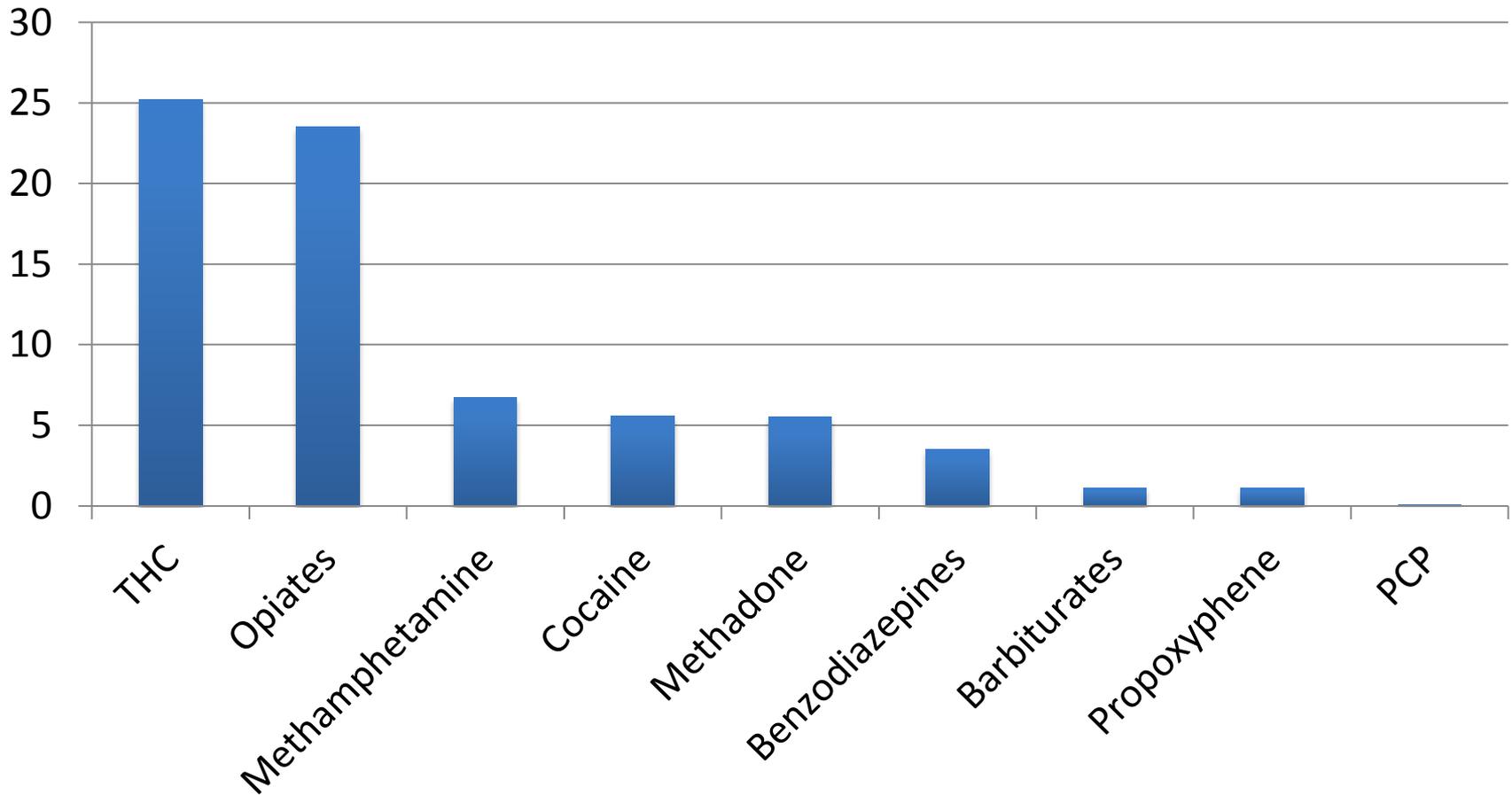


Umbilical cord tissue

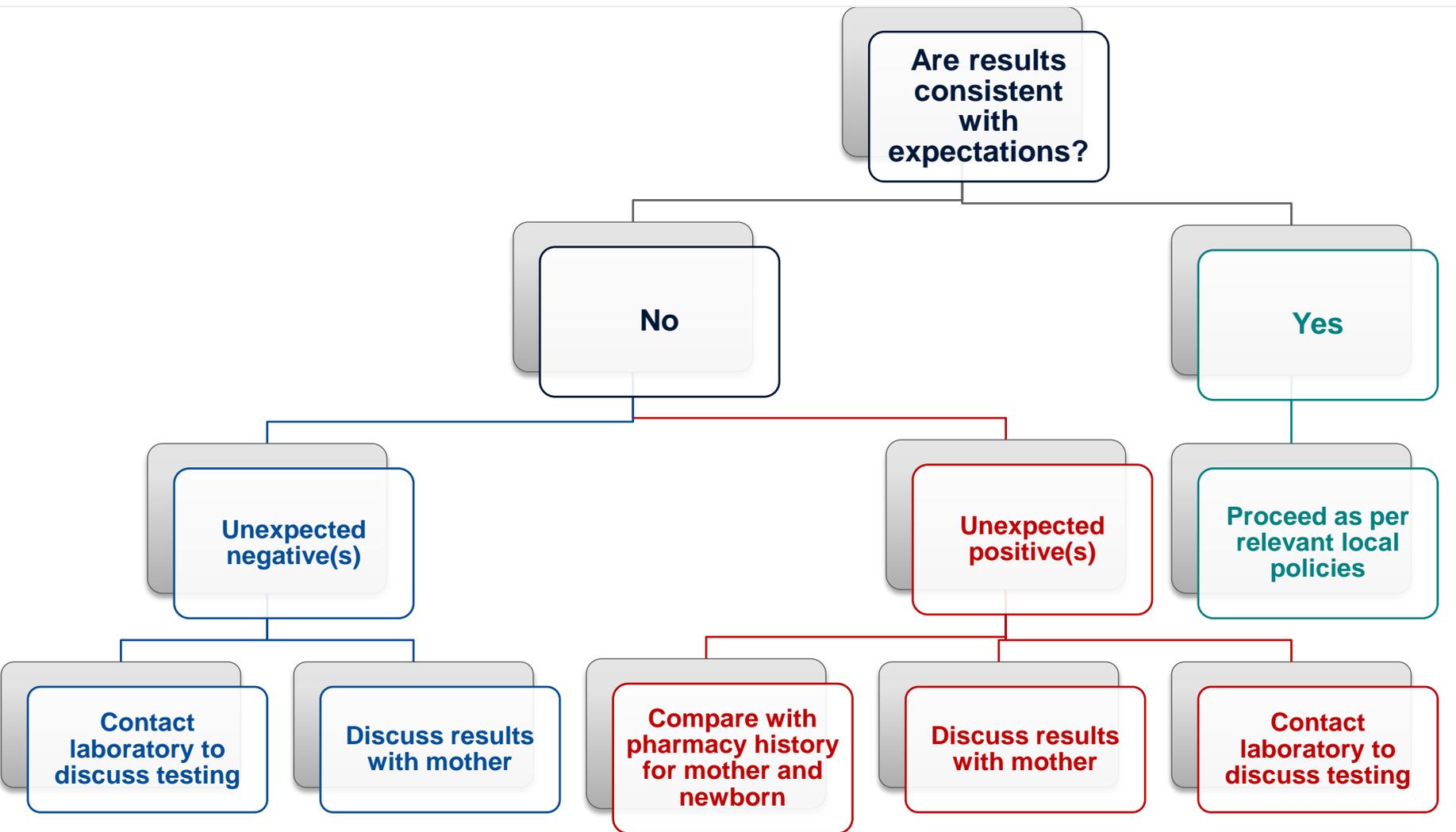
- Forms ~5th week of gestation
- Grows with fetus throughout pregnancy
- Typically about 20 in long with full term births
- Drugs appear to deposit consistently across the length of cord
- Easy to collect at time of birth
- Particularly useful for high-risk scenarios wherein time to result is critical
- Concentrations of drug analytes are lower in cord than in meconium, but can be detected with appropriate methods
 - Montgomery et al, *J Perinatol*, 28(11):750-3, 2008
 - deCastro et al, *Ther Drug Monit*, 33(4):443-52, 2011
 - Marin et al, *Ther Drug Monit*, 36(1):119-24, 2014



Overall positivity rate at ARUP ~73% (n=76,631)



Algorithm for evaluation of results



Frequently asked questions

- Can we detect first trimester exposures?
- Can we detect how frequently the mother used drugs, time of last use, and/or how much was used?
- Can we detect drugs administered in the hospital?
- Can we determine how and when a newborn will be affected by drug exposure(s)?
- What if results from twins or triplets don't agree?
- What are the typical patterns of results observed?



Thank-you for your attention

gwen.mcmillin@aruplab.com

Examples of Recent ARUP References

Meconium

- Marin SJ, Merrell M, McMillin GA. (2011). Drugs of abuse detection in meconium: a comparison between ELISA and biochip microarray. *J Anal Toxicol*, 35(1), 40-5.
- Wood KE, Krasowki MD, Strathmann FG, McMillin GA. (2014) Meconium Drug Testing in Multiple Births in the United States. *J Anal Toxicol*, Sep;38(7):397-403.
- Wood KE, Sinclair LL, Rysgaard CD, Strathmann FG, McMillin GA, Krasowski MD. (2014) Retrospective Analysis of the Diagnostic Yield of Newborn Drug Testing. *BMC Pregnancy Childbirth*, 14(1):250. Published online July 29, 2014.
- McMillin GA, Wood KE, Strathmann FG, Krasowski MD. (2015) Patterns of Drugs and Drug Metabolites Observed in Meconium; What Do They Mean? *Ther Drug Monitor*, Jan 6 [Epub ahead of print].

Umbilical cord tissue

- Marin SJ, Christensen RD, Baer VL, Clark CJ, McMillin GA. (2011). Nicotine and metabolites in paired umbilical cord tissue and meconium specimens. *Ther Drug Monit*, 33(1), 80-5.
- Chittamma A, Marin SJ, Williams JA, Clark C, McMillin GA. (2013). Detection of In Utero Marijuana Exposure by GC-MS, Ultra-Sensitive ELISA and LC-TOF-MS Using Umbilical Cord Tissue. *J Anal Toxicol*, 37(7), 391-4.
- Marin SJ, Metcalf A, McMillin GA. (2014) Comparison of Methods for Extraction of Drugs from Umbilical Cord Tissue. [Abstract] *Presented at the Society for Forensic Toxicology Annual Meeting, October 2014.*
- Marin SJ, Metcalf A, Krasowski MD, Linert BS, Clark CJ, Strathmann FG, McMillin GA. (2014). Detection of Neonatal Drug Exposure Using Umbilical Cord Tissue and Liquid Chromatography Time-of-Flight Mass Spectrometry. *Ther Drug Monit*, Feb;36(1):119-24.

Summary and Conclusions

- Meconium and umbilical cord can detect drug-exposed newborns
 - Qualitative results agree well between specimen types, for most drugs
 - Preferred specimen may depend on the hospital model for selection of newborns to test; umbilical cord is available at birth
 - Umbilical cord avoids detection of drugs administered to the newborn
- Drug detection reflects exposure based on test design, drug stability and recovery from the specimen matrix, drug use patterns, and timing of specimen collection relative to drug use
- Interpretation of results requires consideration of maternal admissions, pharmacy history for mother and newborn, and consultation with the laboratory regarding the testing performed



© 2015 ARUP Laboratories