

If Baby Could Talk: Laboratory Detection of Prenatal Drug Exposure

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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

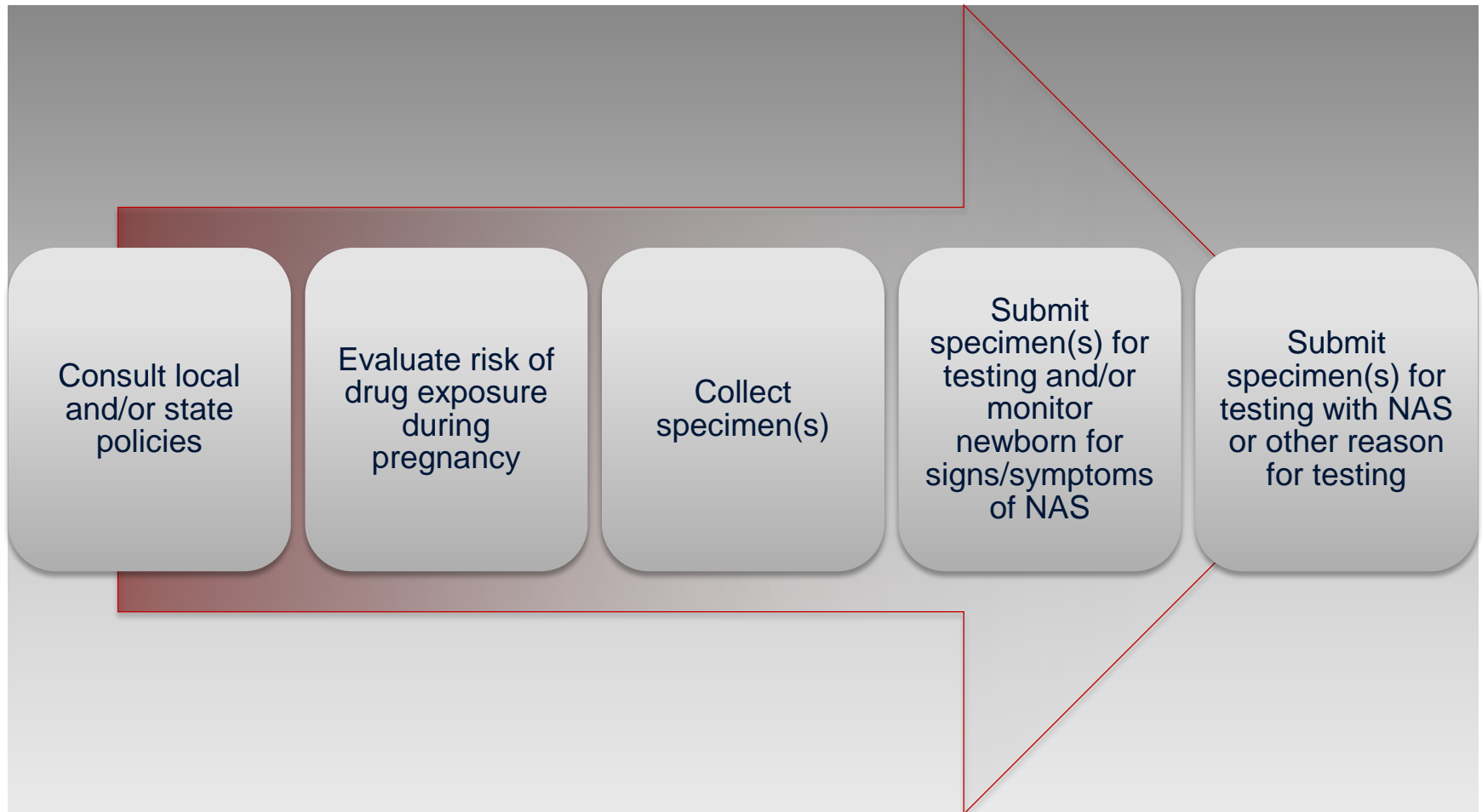


How to detect prenatal drug exposure?

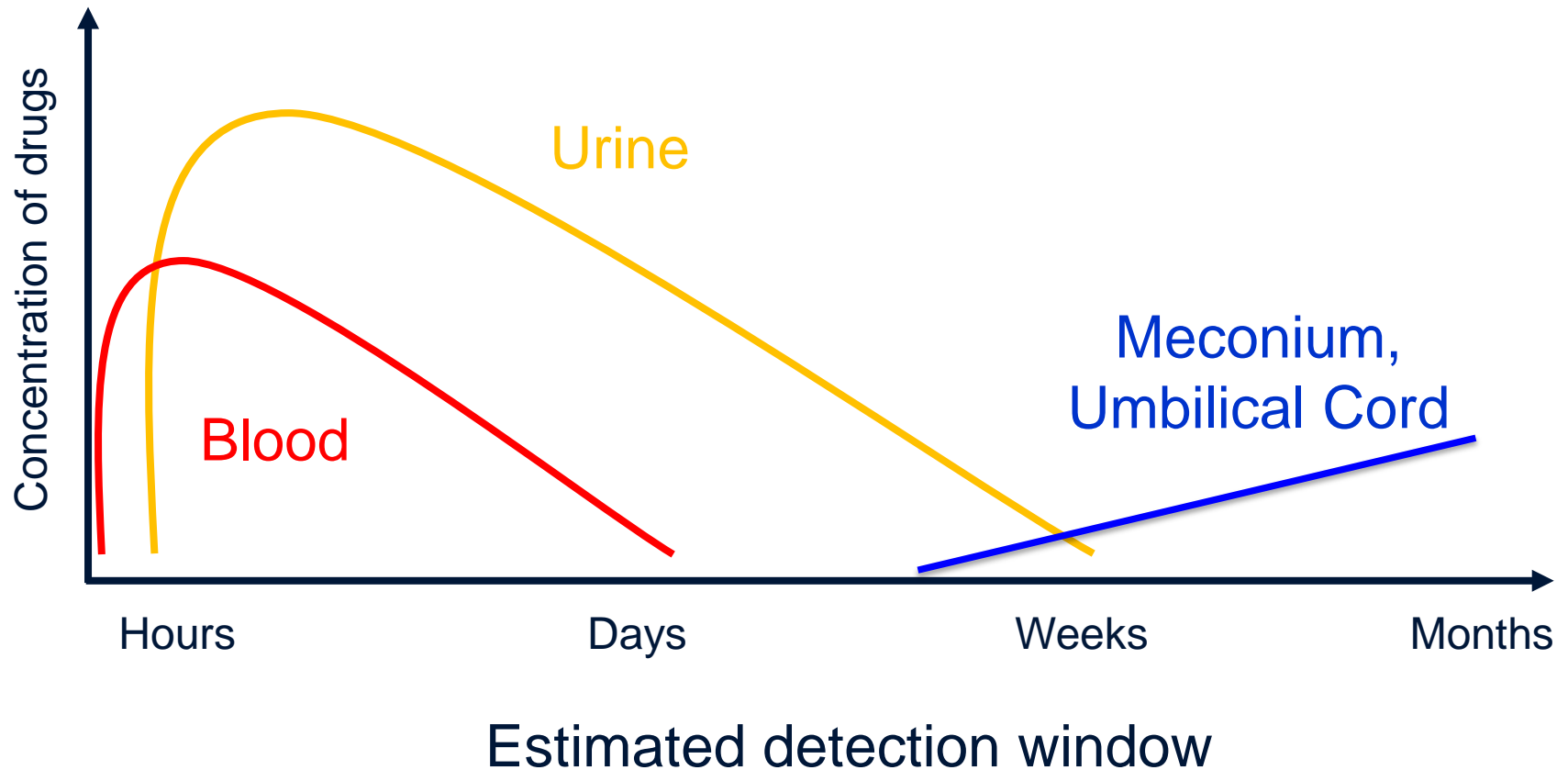
- Maternal self-report
 - Unreliable and under-estimates use
- Maternal testing
 - Serial, comprehensive testing is not practical or cost-effective for most
 - Does not prove that baby was exposed (or not)
- Maternal screening to evaluate risk of exposure
- Newborn testing



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

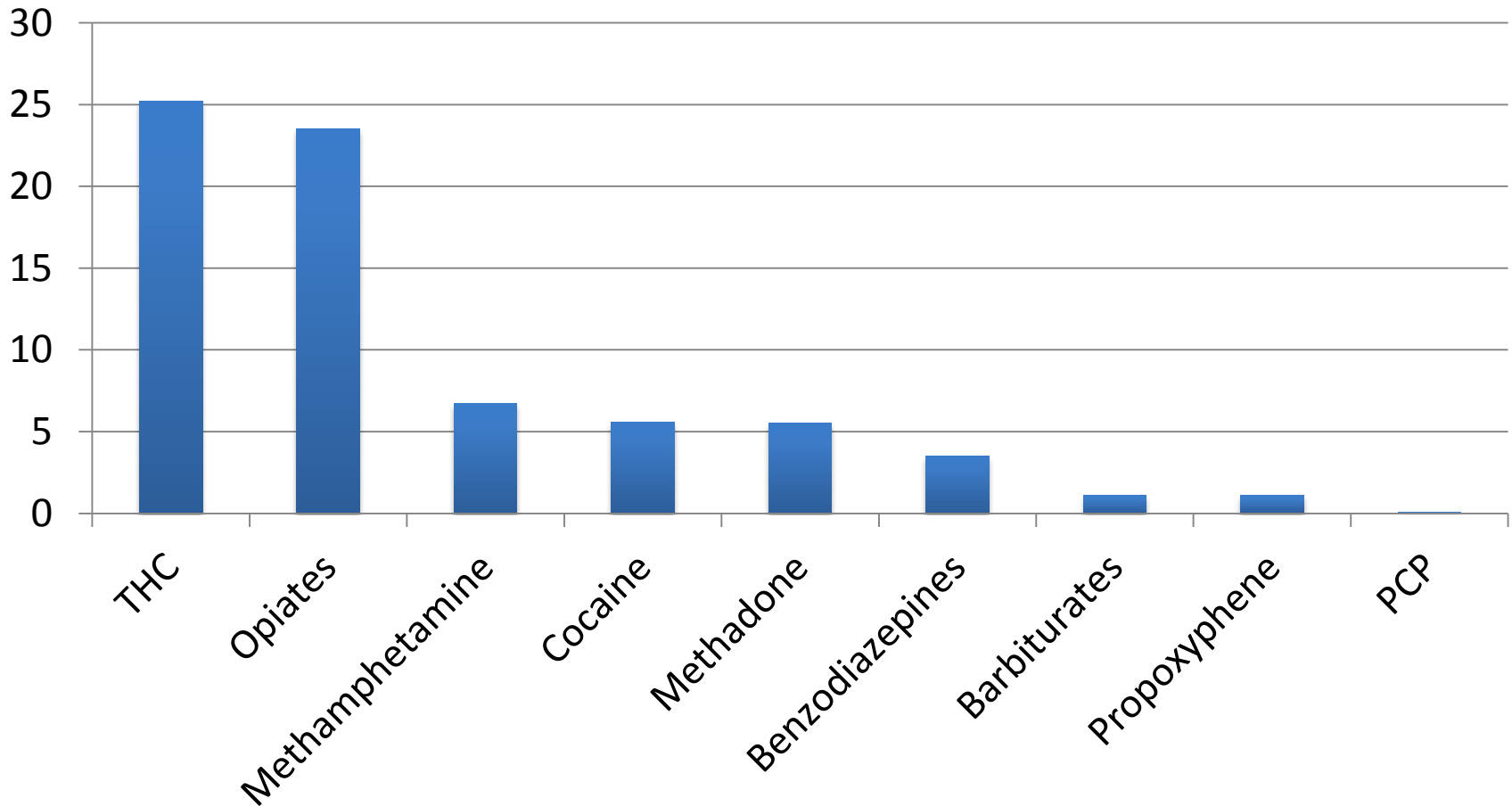


Umbilical cord tissue

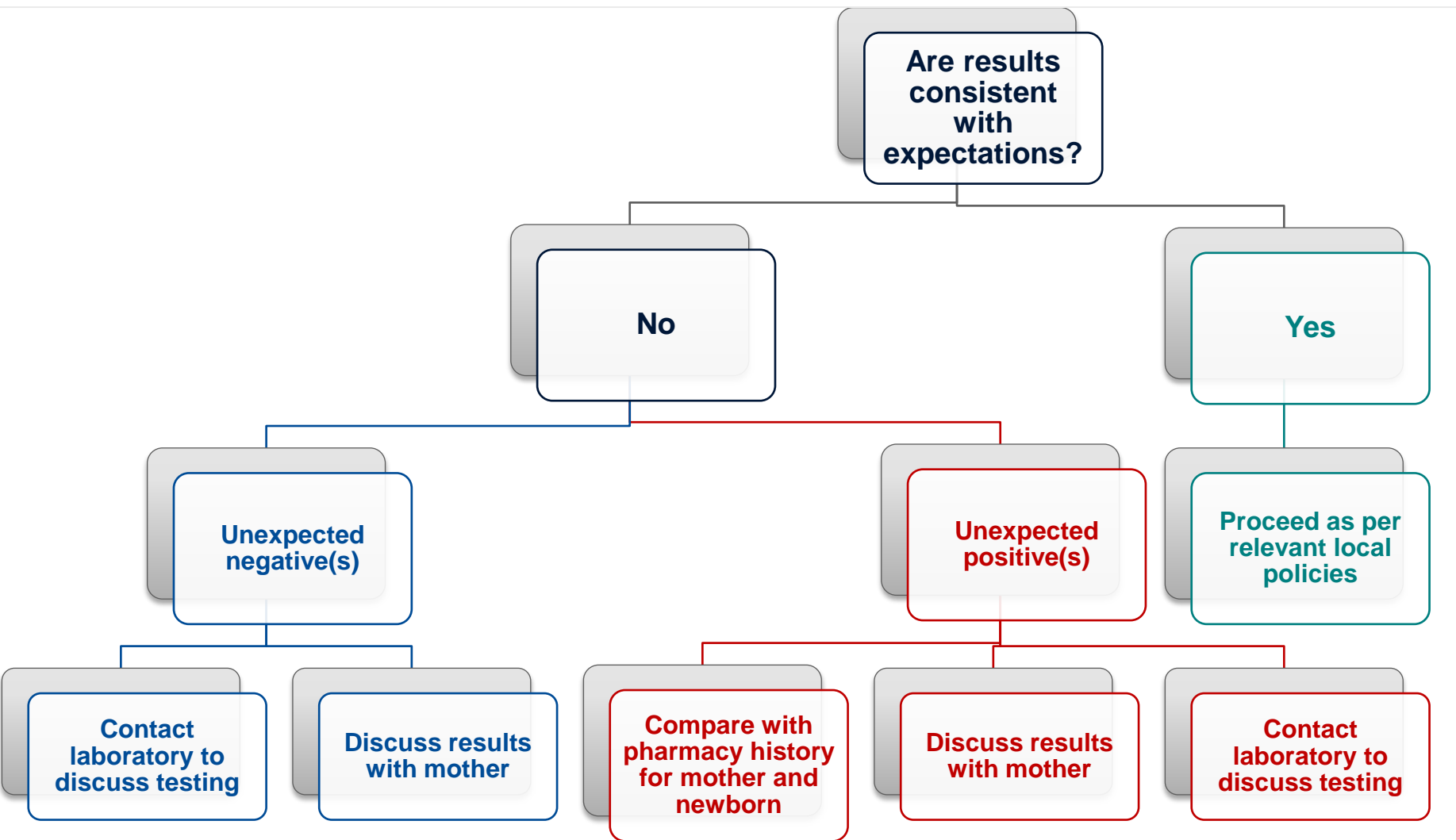
- Forms ~5th week of gestation
- Grows with fetus throughout pregnancy
- Typically about 20 in long with full term births
- Drugs appear to deposit consistently across the length of cord
- Easy to collect at time of birth
- Particularly useful for high-risk scenarios wherein time to result is critical
- 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

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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



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