Biological Specimens and Approaches to Testing Designed to Identify Drug-Exposed Newborns

Gwendolyn A. McMillin
University of Utah and ARUP Laboratories
USA

Scope of the lecture:
This presentation will discuss current approaches for detecting drug-exposed newborns, including maternal and neonate risk factors, biological specimens, analytical approaches and interpretation of results

Learning objectives:
1. Understand major maternal and neonate risk factors associated with in utero drug exposure
2. Describe advantages and disadvantages of biological specimens that have been used to detect drug-exposed newborns
3. Explain how drug newborn testing results should be interpreted

Extended abstract:

Substance abuse during pregnancy is a significant problem in the United States, Canada, Europe and other parts of the world. In the United States it is estimated that 10-11% of all births are affected by prenatal alcohol or illicit drug exposure. It has been reported that the incidence of neonatal abstinence syndrome (NAS) increased by 300% from 1999 to 2013, among 28 states that participated in the survey, and more than 75% of newborns exposed to drugs in utero have major medical problems. This is in large part attributed to the opioid epidemic. Geographical variation in drug accessibility and drug use patterns around the world contributes to the drugs most likely to contribute to in utero drug exposure, making it necessary for each facility to develop appropriate algorithms and testing, relevant to the patient population served. The incidence of chronic behavioral, cognitive and developmental problems is also a consequence of in utero drug-exposure. Antenatal care and interventions have been shown to improve maternal and neonatal outcomes and may decrease the need for long-term care. As such, accurate and timely detection of in utero substance exposure is critical to making informed social and medical management decisions for the newborn, the mother, and caregivers.

Testing biological specimens to identify drug-exposed newborns is an important tool because maternal self-reporting is often unreliable and inadequate. Regardless of the fact that pregnant women often deny or underreport drug use, a comprehensive and accurate history of the specific drugs used, amounts of each, frequency and duration of use, and other related details is difficult for anyone to recall for a period of time as long as pregnancy. As such, screening tools such as questionnaires that determine risk of substance abuse are used. Examples of maternal risk factors that have been best correlated with illicit drug use include past history of high risk behaviors such as drug abuse or prostitution, regular use of nicotine, limited prenatal care, and unexplained obstetric events (e.g. placental abruption or premature labor). Examples of newborn risk factors include low birth weight and size, symptoms of NAS and unexplained neurological complications. A standardized and objective protocol can help avoid bias, prevent discrimination in testing and minimizes the risk of drug-exposed newborns being missed. The most common specimens utilized for detection of drug exposed newborns include urine, meconium and umbilical cord tissue. A summary of specimens and associated characteristic to consider when selecting the best specimen to test are summarized in Table 1 below.

Aligning results obtained with multiple biological matrices will improve confidence in detection of drug exposure during pregnancy, and may be used to estimate the chronology of exposure. However, in practice, discrepancies in drug testing results obtained with different specimens are common. Confounding factors include the stability and pharmacokinetics of individual drugs and drug metabolites and deposition of drugs and drug metabolites in each specimen type. Each type of specimen has its own pros and cons, reflects exposure at a specific time-period, and shows differences in the predominant parent drug and metabolites which may vary based on the time between drug administration/exposure, unique aspects of

drug metabolism, and specimen collection. Because the availability and quality of specimens, specimen handling, analytical method performance, and properties of specific drugs will influence detection rates, one specimen is not always preferred over another. Detection windows also depend on the specific drug(s) used, the patterns of drug use, the quality and quantity of the specimen submitted for testing and the performance characteristics of associated laboratory testing.

Specimen Type	Approximate Detection Window	Adulteration or external contamination of major concern	May detect drugs administered during labor and delivery	May detect drugs administered directly to the newborn	May require multiple collections
Urine	Hours-Days	X	X	X	X
Placenta	Hours-Days		X		
Amniotic Fluid	Hours-Days		X		X
Vernix	Days-Weeks				
Meconium	Weeks-Months		X	X	X
Umbilical Cord Tissue	Weeks-Months		X		
Maternal Hair	Weeks-Months	X	X		
Neonatal Hair	Weeks-Months			X	
Neonatal Nails	Weeks-Months	X	X	X	