



## Toxicology Section – 2011

### K36 The Uncertainty of Hair Analysis for Drugs and Poisons

*Madeline A. Montgomery, BS, and Marc A. LeBeau, PhD\*, Federal Bureau of Investigation Laboratory, 2501 Investigation Parkway, Quantico, VA 22135; Mark L. Miller, PhD, Federal Bureau of Investigation, 2501 Investigation Parkway, CFSRU, FBI Lab, Quantico, VA 22135; Cynthia L. Morris-Kukoski, PharmD, Federal Bureau of Investigation Laboratory, 2501 Investigation Parkway, Quantico, VA 22135; Sarah K. Himes, BS, National Institute on Drug Abuse, Biomedical Research Center (BRC), 251 Bayview Boulevard, Suite 200, Room 05A505.19, Baltimore, MD 21224; and Roman Aranda, PhD, Jason E. Schaff, PhD, and Jason D. Brewer, PhD, Federal Bureau of Investigation Laboratory Division, 2501 Investigation Parkway, Quantico, VA 22135*

After attending this presentation, attendees will appreciate the various factors that contribute to uncertainty in interpreting results of hair analyses for drugs and poisons.

This presentation will impact the forensic science community, as well as, the field of forensic toxicology by providing a better understanding of the significance that hair growth, collection, external contamination, and the uncertainty in quantitative measurements play in interpreting the results of hair analyses for drugs and poisons.

Analysis of hair for drugs, poisons, and their metabolites has been widely reported in the scientific literature over the past two decades. There are a number of fundamental assumptions in interpreting results of these analyses including: (1) an average linear growth rate of hair of 1 cm per month; (2) sample collections occur with the hair being cut directly next to the scalp; (3) external contamination can be differentiated from ingestion; and (4) differences in measured concentrations between hair segments indicate a change in exposure.

This presentation will evaluate each of the above assumptions and provide useful information to help the attendee fully appreciate how measurement uncertainty plays an important role in interpreting the results of hair analysis for drugs and poisons. The results of a thorough review of hair growth studies will be presented and a more realistic growth rate of  $1.4 \pm 0.5$  cm/month will be proposed. Separately, the results of a hair collection study will be discussed. The results of this study suggest that an average of  $0.8 \pm 0.2$  cm of hair may be left on the scalp after collection, corresponding to  $0.6 \pm 0.3$  months of hair growth. The current status of the effect that external contamination may have on positive findings in hair will be addressed. Finally, the role that measurement uncertainty of quantitative results will be addressed with examples provided that demonstrate the limitations that uncertainty presents in assessing concentration differences between hair segments.

#### **Measurement Uncertainty, Hair, Segmental Analysis**