

# Behavioral Health is Essential To Health



Prevention Works



Treatment is Effective



People Recover



# *The Science of Hair Testing*

## Summary of Literature Review

Presented by  
SAMHSA's Division of Workplace Programs

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# Literature Summary – Topic Areas

- Articles from last 10 years
  - General Review (6)
  - Collection (1)
  - Passive Exposure in Children (9)
  - Proficiency Testing (1)
  - Decontamination procedures (6)
  - Drug specific studies (15)
  - Methodologies (3)

# General Review

- Hair grows ~1.5cm per month
- Posterior vertex region of scalp preferred for collections
- Drugs can be deposited 3 ways
  - Blood supply
  - Sweat and sebum
  - External environment
    - i.e. Smoke, Surface transfer, Evidence handling
- Wash steps are critical

# Collection

- Collection can vary from person to person
- Individual growth rates also affect amount collected
- Most important if segmented analysis is used

# Passive Exposure in Children

- Children in drug user environments routinely test positive for drugs in hair
- Passive exposure can lead to both external contamination and absorption into the body
- Analysis of drug metabolites and ratios *can* be useful, but are not definitive

# Proficiency Testing

- Historical values from 10+ years ago
- Shows steady improvement

# Decontamination Procedures

- No industry standard
- Procedures involve organic and/or aqueous washes
- Length of washes – ongoing debate
- Commonly accepted that all external contamination cannot be removed
  - Wash criteria [factor of drug concentration in wash solutions] used for interpretation

# Drug Specific Studies

- Han, E., Park, Y., Yong, Y., Lee, J., Lee, S., Kim, E., Lim M., and Chung, H. (2006) The study of metabolite-to-parent drug ratios of methamphetamine and MDMA in hair. *Forensic Sci. Int.* 161: 124-129
  - Examined metabolite ratios in amphetamine class of drugs, variability
- Ropero-Miller J., Huestis M. and Stout P. (2012) Cocaine analytes in human hair: evaluation of concentration ratios in different cocaine sources, drug-user populations and surface-contaminated specimens. *J Anal Toxicol* 36, 390-398.
  - Proposed guidelines from 2004 would not be sufficient to distinguish contamination from use (metabolite ratios, cutoffs for minor alkaloids); melanin relation established

# Drug Specific Studies

- Uhl, M. and Sachs, H. (2004) Cannabinoids in hair: strategy to prove marijuana/hashish consumption. *Forensic Sci. Inter.* 145: 143-147.
  - Helped distinguish external exposure in a couple; confirm a false negative; confirmed passive inhalation in a 2 year old
- Auwarter, V., Wohlfarth, A., Traber, J., Thieme, D. and Weinmann, W. (2010) Hair analysis for  $\Delta^9$ -tetrahydrocannabinolic acid A (THCA-A): New insights into the mechanism of drug incorporation of cannabinoids into hair. *Forensic Sci. Int.* 196: 10-13
  - Presence/Detection of THC-COOH in hair is widely accepted to confirm use; also examines presence of THCA-A as a marker for side stream smoke contamination

# Methodologies

- Angeli, I; Minoli, M.; Ravelli, A.; Gigli, F.; Lodi, F.; Ireland (2012) Automated fast procedure for the simultaneous extraction of hair sample performed with an automated workstation. Forensic Sci. Int. 218:15-19.
  - Automated Solid Phase Extraction (SPE) method for GC/MS confirmation; included wash procedure and minimized carry over; for this study, found to be more efficient than liquid-liquid extraction.

# Methodologies

- Pichini, S., Gottardi, M., Marchei, ., Svaizer, F., Pellegrini, M., Concetta Rotolo, M., Garcia Algar, O., and Pacifici, R. (2013) Rapid extraction, identification and quantification of drugs of abuse in hair by immunoassay (EIA) and ultra-performance liquid chromatography tandem mass spectrometry (UPLC-MS/MS). Clin. Chem. Lab. Med. 0784: 1-8
  - 17 common drugs analyzed
- Gouveia, C., Oliveira, A., Pinho, S., Vasconcelos, C., Carvalho, F., Moreira, R., Dinis-Oliveira, R. (2012) Simultaneous quantification of morphine and cocaine in hair samples from drug addicts by GC-EI/MS. Biomed Chromatogr. 26:1041-1047

# Questions

- If you desire a list of references used for this summary or if you have any comments about the material presented today, send your requests or questions to: [dwp@samhsa.gov](mailto:dwp@samhsa.gov)
- Submitted questions and concerns will be discussed by the Board in closed session