

DIFFERENTIAL CHARACTERISTICS IN URINE VERSUS HAIR DRUG TESTS

**PRESENTATION FOR 2023 ANNUAL CHILD WELFARE
LAW UPDATE**

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2023 Child Welfare Law Update



OUTLINE

- PURPOSE OF DRUG TESTING
- MATRICES USED (URINE, HAIR, BLOOD, ORAL FLUID, BREATH)- FOCUS TODAY ON URINE VERSUS HAIR
- GOVERNING RULES FOR TESTING- REFLECTED IN LAB PROCEDURES
- INFORMATION OBTAINED BY SPECIFIC MATRICES
- QUALITY ASSURANCE MEASURES TO INSURE ACCURACY IN REPORTING
- METHODS EMPLOYED AGAINST DRUG DETECTION
- REFERENCE SOURCES

RATIONALE FOR DRUG TESTING -

1) A MEANS TO DETER USE, IDENTIFY AND REHABILITATE THE USER, AND IDENTIFY DRUG USED FOR TREATMENT PURPOSES.

2) IDENTIFYING DRUG ABUSE IN A FAMILY AND ASSESS SAFETY RISKS TO CHILDREN/OTHER FAMILY MEMBERS

Drug testing is being done by:

- Governmental agencies (US DOT, DHHS)
- Private employers (subject to state rules DOH Chapter 113)
- Criminal justice system/ Family Courts
- Hospitals/Emergency rooms/ OP Pain Management Programs

XII. Specimen Types:

Pros and Cons of Different Specimen Sources

Specimen	Window of Detection	Pros	Cons
Urine	Up to 2–4 days	<ul style="list-style-type: none"> • Most accurate results • Least expensive • Most flexibility for testing different drugs • Most likely to withstand legal challenge 	<ul style="list-style-type: none"> • Specimen can be adulterated, substituted, or diluted • Limited detection window • Collection can be invasive or embarrassing • Specimen handling and shipping can be hazardous
Oral Fluid	Up to 48 hours	<ul style="list-style-type: none"> • Collecting the oral fluid specimen can be observed • Minimal risk of tampering • Noninvasive • Can be collected easily in virtually any environment • Can be used to detect alcohol use • Can be used to detect recent drug use 	<ul style="list-style-type: none"> • Drugs and drug metabolites do not remain in saliva as long as in urine • Less efficient than other testing methods for detecting marijuana use • pH changes can alter specimen • Moderate to high cost
Sweat	FDA cleared for 7 days	<ul style="list-style-type: none"> • Relatively noninvasive • Sweat patch typically worn for 7 days • Quick application and removal of sweat patch • Patch seal tampering minimized • Longer window of drug detection than urine and blood • Relatively resistant to specimen adulteration • No specimen substitution possible 	<ul style="list-style-type: none"> • Only a few laboratories offer sweat patch testing • Those with sensitive skin may react to the patch • Possible time-dependent drug loss from the patch • Possible external drug contamination from improper skin cleansing prior to application • For marijuana, current use by a naïve user may not be detected • For marijuana, positive sweat results are possible in current abstinent, but previously chronic high dose, users • Sweat production dependent • Moderate to high cost
Hair	Up to 4-6 months	<ul style="list-style-type: none"> • Collecting the hair specimen can be observed • Long detection window • Does not deteriorate • Can be used to measure chronic drug use • Convenient shipping and storage; needs no refrigeration • Noninvasive • More difficult to adulterate than urine 	<ul style="list-style-type: none"> • Moderate to high cost • Cannot be used to detect alcohol use • Cannot be used to detect drug use 1–7 days prior to drug test • Not effective for compliance monitoring • External contamination
Breath	Up to 12-24 hours	<ul style="list-style-type: none"> • Minimal cost • Reliable detector of presence and amount of alcohol • Noninvasive 	<ul style="list-style-type: none"> • Very limited detection window for alcohol • Can only be used to detect presence of alcohol
Blood	Up to 12-24 hours	<ul style="list-style-type: none"> • Can be used to detect presence of drugs and alcohol • Test produces accurate results 	<ul style="list-style-type: none"> • Invasive • Moderate to high cost
Meconium	Up to 2-3 days	<ul style="list-style-type: none"> • Can be used to detect long-term use • Can be used to detect presence of drugs and alcohol • Easy to collect and highly reliable 	<ul style="list-style-type: none"> • Short detection window after infant's birth

(Office of National Drug Control Policy, 2002; Substance Abuse and Mental Health Services Administration, Center for Substance Abuse Treatment, 2006)

MATRICES FOR DISCUSSION

Urine-Non-Invasive, subject to potential adulteration/alterations

Detection Window $\sim < 1\text{hr}$ to 3-5 days

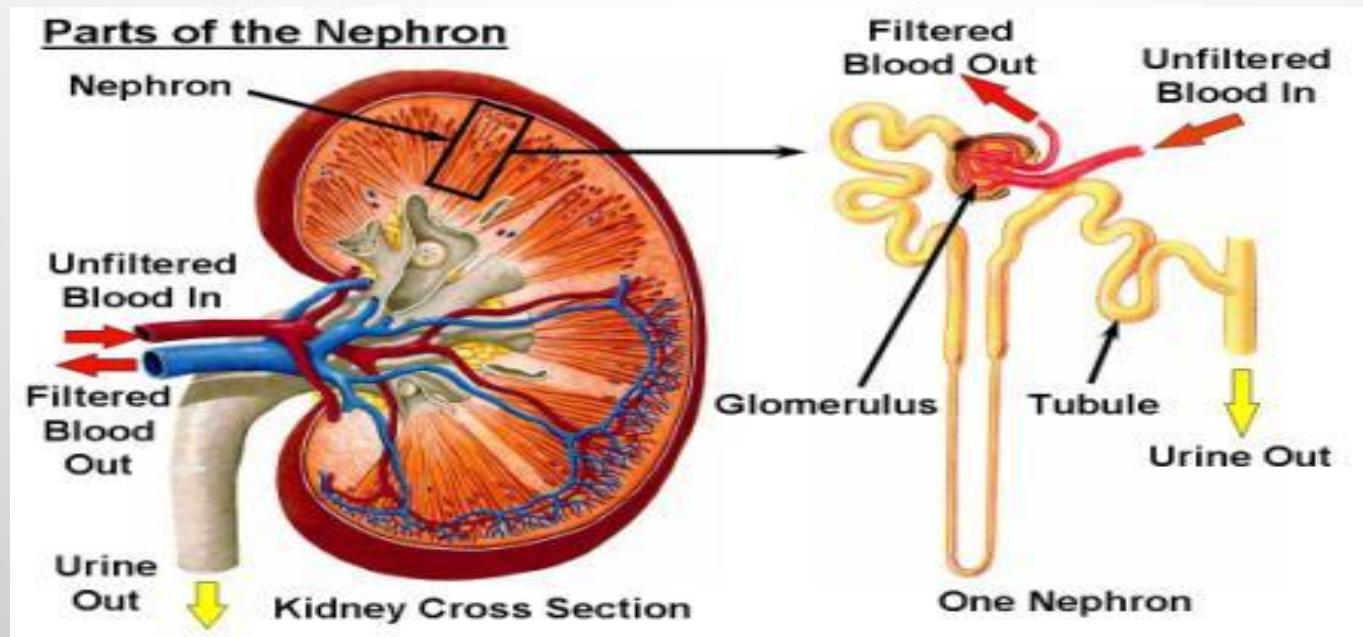
Drugs enter blood stream via stomach/GI tract (oral), I.V., or lungs (inhalation) and are filtered via kidneys into urine; drug elimination after liver-mediated metabolism and directed into either urine or fecal tracts.

Hair- Non-Invasive, subject to counter measures (bleaching, shaving)

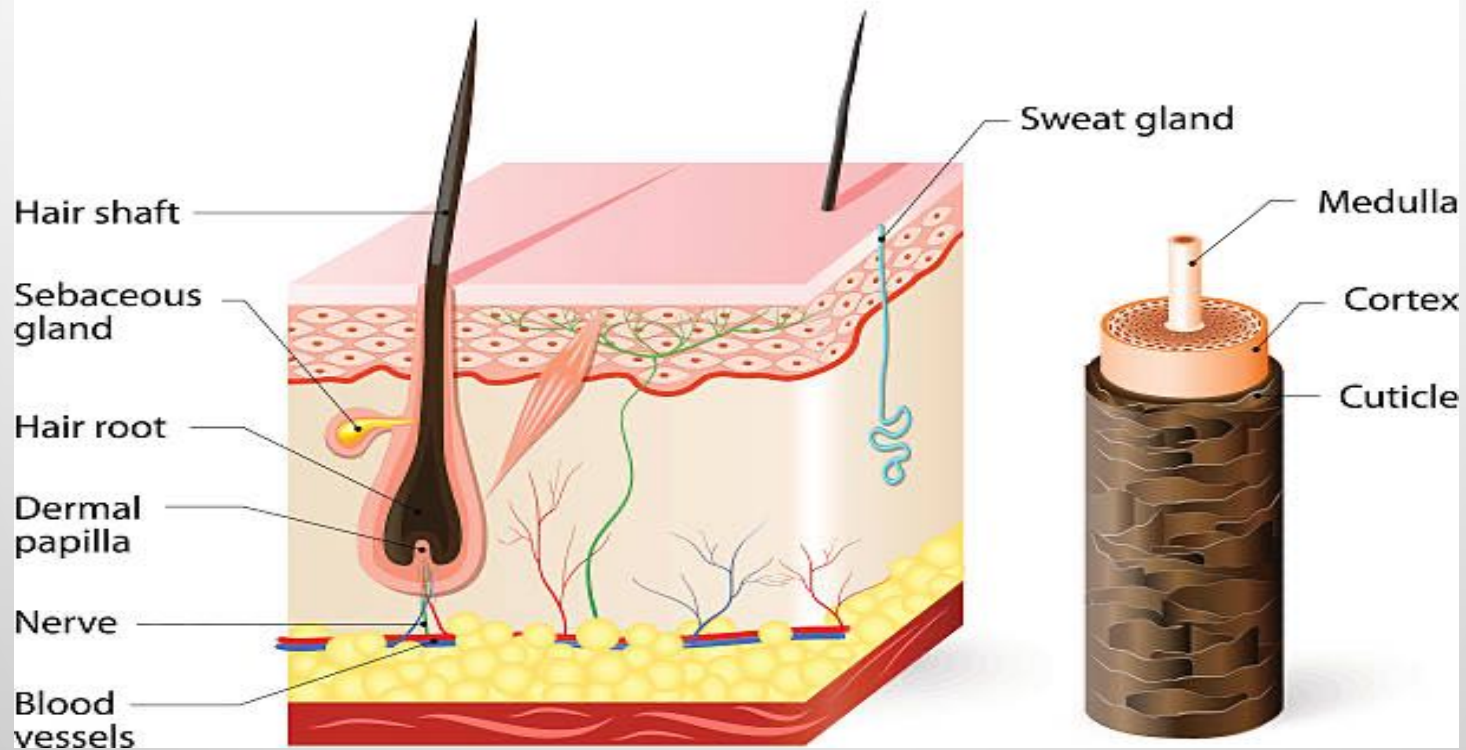
Detection Window ~ 0.5 months to 3 months (depending on hair length with drug fixation and migration with strand growth rate ~ 0.5 inches per month) away from the hair root with hair growth. Head posterior vertex region has most consistently even hair growth rate.

Drugs enter hair strand from blood stream via oral ingestion, I.V. or inhalation as well as enter via sebaceous (oil) and sweat glands around hair follicle and the vasculature (blood) system. Melanin mediates drug fixation.

KIDNEY ANATOMY



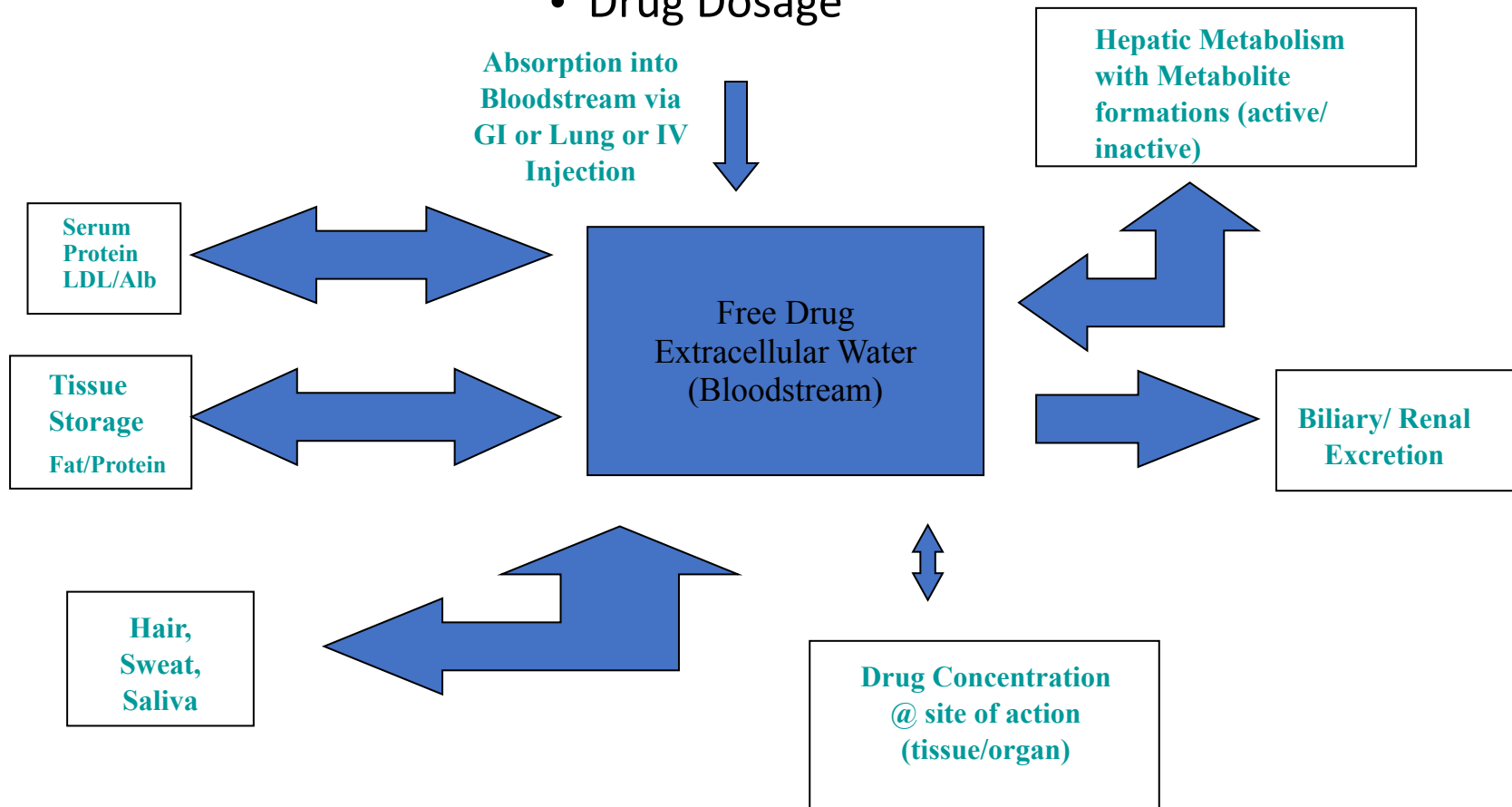
HAIR ANATOMY



Distribution Pathways

- Drug Dosage

Absorption into
Bloodstream via
GI or Lung or IV
Injection



PROCEDURES AND CHAIN OF CUSTODY: MUST ADDRESS

- **COLLECTION**

- OBSERVED VERSUS PRIVATE BOOTH COLLECTION TECHNIQUES (MINIMUM AMOUNTS MUST BE OBTAINED (ML/MG)
- CONDUCTED BY TRAINED CERTIFIED PERSONNEL
- SPECIMEN SECURED BY TAMPER-EVIDENT SEAL/SIGN OFF OF SAMPLE ON CUSTODY FORMS

- **TRANSPORTATION**

- SEALS MUST REMAIN UNBROKEN TO LAB

- **TESTING**

- SIGNOFF OF SAMPLE AT LAB (LAB ACCESSION/PERSON TESTING)
- TESTING PERFORMED ACCORDING TO VALIDATED METHODS BY AN ACCREDITED LABORATORY AND REVIEWED BY QUALIFIED SCIENCE OFFICER
- COMPLIANCE WITH OVERSIGHT ORDINANCES (FEDERAL/STATE/LOCAL/CLINICAL)

- **REPORTING**

- POSITIVE/NEGATIVE BY CUTOFF OR REPORT LIMITS, ALL POSITIVES CONFIRMED BY DIFFERENT CHEMICAL METHOD IDENTIFYING DRUG PRESENCE AND QUANTITY (NG/ML OR NG/G)
- WHAT AND WHO TO REPORT TO (RESTRICTED RECIPIENTS /HIPAA INVOLVEMENT? - NO MRO INTERMEDIARY)

ANALYTICAL METHODS

Screening (rapid filtering of negative specimens)

- 1) Immunoassays with specified cutoff detection limits
- 2) LCMSMS/LCMSTOF- low/high resolution mass spectrometry

Confirmation (absolute ID of specific drug and quantity)

- 1) Identification/quantitation by different chemical method from screen method
- 2) Gold Standard- GCMS, LCMS, LCMSMS, LCQTOF (high/low resolution mass spectrometry)

Note: All methods must be rigorously validated and reviewed by accrediting organization (CAP, CLIA, ANAB, ISO 17025)

INTERPRETATION OF RESULTS

Urine (45-60 ml minimum required)

-**Negative** (either none detected or below cutoff limit of report)

-**Positive** (specific drug identified along with concentration (ng/mL)

Donor was exposed to identified drug between 1hr to ~5 days (acute to possible chronic use). Exposure time may be ~6-30 days for chronic cannabis users.

Normalized THC-carboxy/creatinine (ng/mg) ratios can determine renewed cannabis use after abstinence.

-**Cancelled** -Unable to Determine due to interfering substances or specimen is ruled **invalid** by either pH, SpG, or creatinine criteria (urine properties not consistent with a normal specimen.

-**Adulterated/Substituted** means test refusal due to identified adulterant or creatinine/SpG criteria.

INTERPRETATION OF RESULTS

Hair (whole or segmented ≥ 100 mg)

- Negative** (either none detected or below cutoff limit of report)
- Positive** (specific drug identified along with concentration (ng/mL), identified drug metabolite must also be detected to prove drug metabolism in vivo ingestion)
- Unable to Determine** due to interfering substances or failing criteria for positive identification or insufficient specimen amount.
- Note per SoHT: Hair test results cannot be used to refute a positive urine test. Infrequent or single use may provide concentrations below reporting limits of detection.
- Segmented analysis (0.5-inch segments of hair from root end) can approximate time of exposure.

URINE SPECIMEN VALIDITY TESTS-1

- ACCEPTABLE CRITERIA (FEDERAL/STATE REGULATIONS):
- TOTAL VOLUME MUST BE MINIMUM OF 45 ML (SPLIT SPECIMEN A = 30 ML, B = 15 ML) OR MUST RECOLLECT, NO POOLING ALLOWED
- CREATININE \geq 20 MG/DL; SPECIFIC GRAVITY $>$ 1.002 ; TEMPERATURE = 90-100 F; PH = 3.0-11.0; “NORMAL” COLOR/SMELL
- IMMEDIATE RECOLLECTION WITHIN 3 HR FOR “ABNORMAL URINE”, MUST BE WITNESSED (UPON EMPLOYER APPROVAL FOR NON-FED)
- “SHY BLADDER” – (INSUFFICIENT VOLUME RECEIVED) 3 HR SUPERVISED WAIT PERIOD. WATER INTAKE LIMITED TO TOTAL 40 FL. OZ. WATER AT EVEN VOLUMES AND INTERVALS WITH DOCUMENTATION

URINE SPECIMEN VALIDITY-2

- **DEFINITIONS:**

- **DILUTE**- CREATININE <5 MG/DL ;SPECIFIC GRAVITY <1.003 ; IF NEGATIVE, SPECIMEN IS ACCEPTED AS VALID NEGATIVE, BUT SUBSEQUENT RANDOM TESTS CAN BE OBSERVED OR ORDERED MORE FREQUENTLY.
- **SUBSTITUTED**- CREATININE ≤ 2.0 MG/DL; SPECIFIC GRAVITY ≤ 1.0010 OR ≥ 1.0200 ; INTERPRETED AS A TEST REFUSAL
- **ADULTERATED**- IDENTIFICATION AND QUANTIFICATION OF ADULTERANT, E.G. NITRITE, CHROMATES, BLEACH, CORROSIVES (PH <3.0 OR >11.0), OXIDIZERS (PEROXIDASE); INTERPRETED AS A TEST REFUSAL
- **CANCELLED TEST**- ANY ADULTERATED SPECIMEN THAT CANNOT BE IDENTIFIED AND QUANTIFIED. RECOLLECTION AND RETEST SHOULD BE ORDERED
- **INVALID** TEST- PH ≥ 3 TO 4.49 ; ≥ 9.00 TO 11.00 ; CREATININE ≥ 2.0 TO 4.99 , SPECIFIC GRAVITY >1.0010 TO <1.0030 ; OR > 1.0200 ;UNIDENTIFIED/ UNQUANTIFIED ADULTERANT –RESULTS IN CANCELLED TEST.

Why do people adulterate urine?

- Get a job
- Keep a job
- Get out of jail
- Stay out of jail
- Maintain child custody



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EVASIVE MEASURES IN DRUG TESTING

Adulteration Techniques



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Methods of Urine Adulteration

In Vivo

- Body Flushes-dilution
- Drinking Excess fluids
- Household or commercial drinks
- All above listed methods result in lower creatinine concentrations/SpG**

In Vitro

- Addition** -Sample tampering by chemical additives
(Household or commercial additives to urine while urinating to impair drug detection)
- Substitution** - surreptitious addition of synthetic negative urine (via Whizzonator™ or other hidden container held close to crotch area)

The Whizzonator™

IN VIVO Techniques

- Drinking water, cranberry juice, vinegar, and bleach: *all are diuretics, others are:*
 - Test Free (Ultimate Blend): 4 hr effectiveness
 - Test Clean: 4-5 hr effectiveness
 - Goldenseal Tea: myth
 - Detoxify Carbo Clean
 - Naturally Klean Herbal Tea
 - Vales Original formula

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Remedial Action for In Vivo Urine Adulteration

- Observed urine collection by collector of same gender where urine flow can be seen to originate from body orifice to urine cup.
- Rapid compliance/reduced time response to notification for testing (on unannounced random basis)
- Ask laboratory to perform all urine specimen validity testing available (minimum: pH, specific gravity, creatinine) to determine dilution, substitution criteria.

Hair Test Evasion Methods

- Head shaved or cut very close to scalp
- Hair bleached or dyed (bleaching can oxidize drugs in hair)
- Remedial Action – use another hair source (arm pit, chest, facial hair, or pubic region (only with collector/donor consent))
- Insure in policy that collection site notifies CW officer immediately if circumstances for normal hair collection are extraordinary and notate occurrences

POSSIBLE OUTCOMES/FINAL REPORT

- NEGATIVE
- NEGATIVE-DILUTE
- REJECTED- UNUSUAL SMELL, COLOR, VOLUME WITH SUPPORTING REMARKS
- POSITIVE, WITH DRUGS NOTED AND QUANTIFIED
- POSITIVE, WITH DRUGS NOTED AND QUANTIFIED, DILUTE NOTATION IF CRITERIA INDICATED
- ADULTERATED, WITH SUPPORTING IDENTIFICATION/QUANTIFICATION REMARKS
- SUBSTITUTED, WITH SUPPORTING DATA AND REMARKS
- INVALID RESULTS, WITH REMARKS AND RULING OF CANCELLED TEST

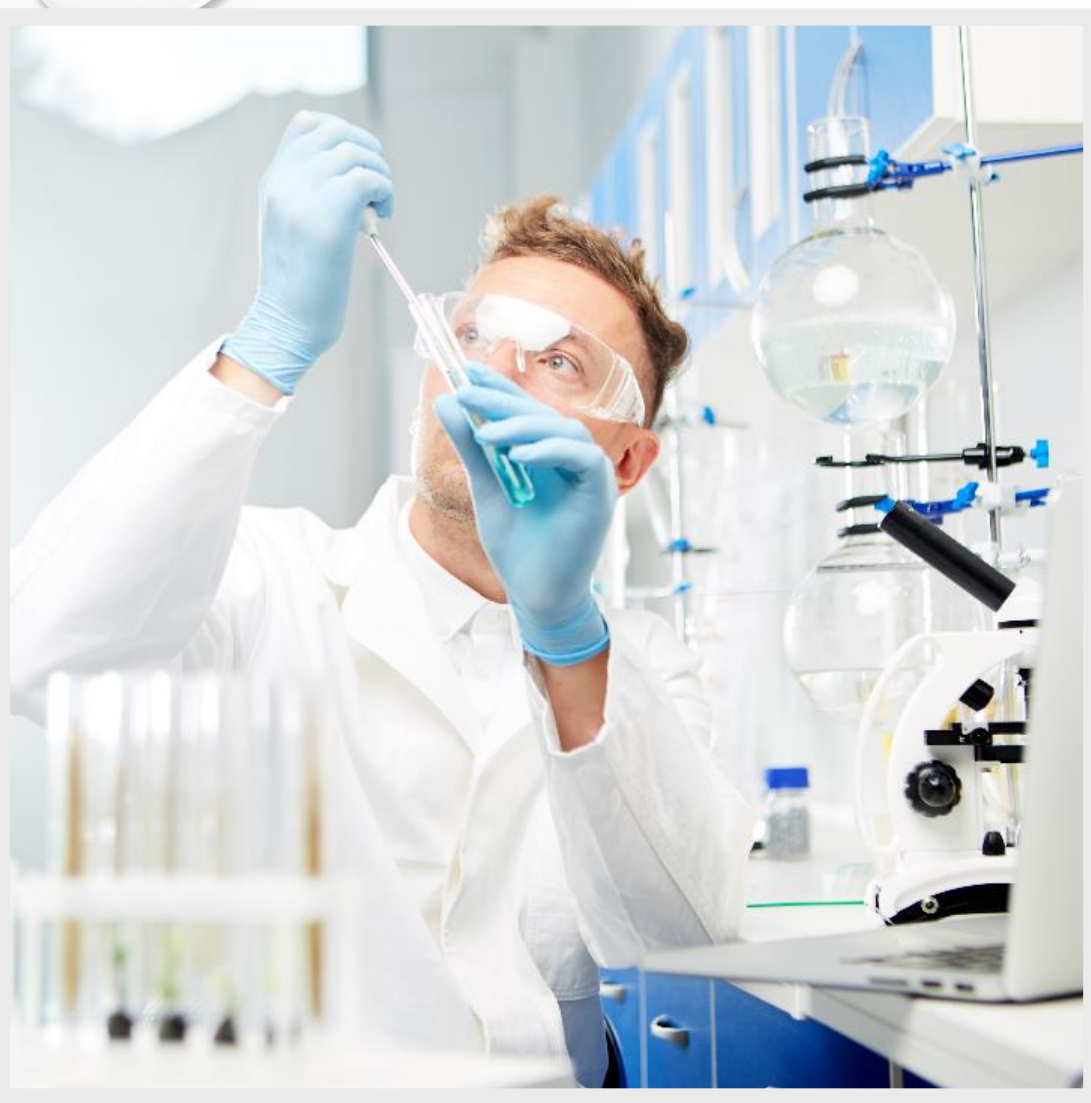
INFORMATION RESOURCES

Society of Hair Testing (SoHT)- see website for resources, published guidelines are in J. Forensic Sci. International, **218**, (2012)pp20-24 where cutoff limit recommendations are published.

Federal DHHS Mandatory Guidelines for Workplace Drug Testing- 82 Fed Register 7920, (2017), pp7920-7970.

State DOH Workplace Rules, Title 11, Chapter 113 (see state DOH website)

“Update on Urine Adulterants and Synthetic Urine Samples to Subvert Urine Drug Testing” by Vikingsson et al., Journal of Analytical Toxicology, 46, (2022) pp. 697-704.



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