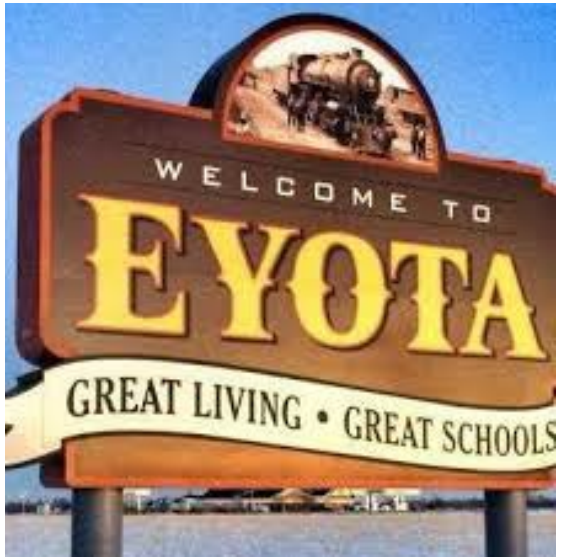
Toxicology Testing for HPSP

Hannah M. Brown, PhD, DABCC

Presented to HPSP Advisory Committee

May 2026

My full-circle journey back to Minnesota.



ST · OLAF COLLEGE

BA in Chemistry and Political Science

My full-circle journey back to Minnesota.

PURDUE UNIVERSITY

PhD in Chemistry

Washington University in St. Louis SCHOOL OF MEDICINE

Clinical Chemistry Fellowship

Hennepin Healthcare

MEDICAL SCHOOL

UNIVERSITY OF MINNESOTA

Driven to Discover®

August 2024 - Present

Learning Objectives

1. Describe the HPSP toxicology testing process at HHS/HCMC.

2. Discuss advantages and disadvantages of alternative matrices.

3. Explain the process of validating methods to detect new drugs of interest.

A Few Words about Hennepin Healthcare

A repurposed sales tax is critical to sustain essential care.

Hennepin Healthcare faces a severe fiscal cliff and potential closure as a result of recent federal cuts and growth of uncompensated care. A repurposed sales tax would ensure continued operations of the health system and critical care for patients when they need it most.

Hennepin Healthcare is a statewide resource for patients.

Health systems across Minnesota depend on Hennepin Healthcare as a cornerstone of our state's care delivery system. It is Minnesota's premier Level I trauma center for adult and pediatric patients, home to the state's regional burn and hyperbaric centers, and a leading academic medical and research institution which trains more than half of Minnesota's healthcare workforce. Their role is not optional -- it is foundational.

Two pieces of state legislature (S.F. 4986/H.F. 4841) to help preserve Hennepin Healthcare which serves as a statewide resource. The health and safety of patients across our state depend on it.

The deadline to pass the bill is midnight on May 18, 2026.

- The Senate tax bill includes Senator Rest's 0.25% rate sales tax proposal (rather than our ask for a 1% rate) and was passed out of committee.
- Additionally, the Senate Health and Human Services bill includes one-time funding through a Hennepin Healthcare Stabilization grant. This bill passed the Senate and is headed to the House for a vote.
- As a reminder, as legislators are exploring this and other ideas around funding solutions to help support our health system, we continue advocating for a long-term, sustainable solution through our request for an ongoing 1% Hennepin County sales tax that would allow us to stabilize operations and address our significant capital needs.

You can help HHS today!

Please consider contacting your state legislators about the role HHS/HCMC plays as a statewide asset.

Drug Testing for HPSP

What is the purpose of drug testing?

Activity #1

1) **Separate**
2) **Detect**

Targeted drugs at clinically relevant concentrations with high analytical sensitivity and specificity

The HHS Toxicology Laboratory offers world-class service.

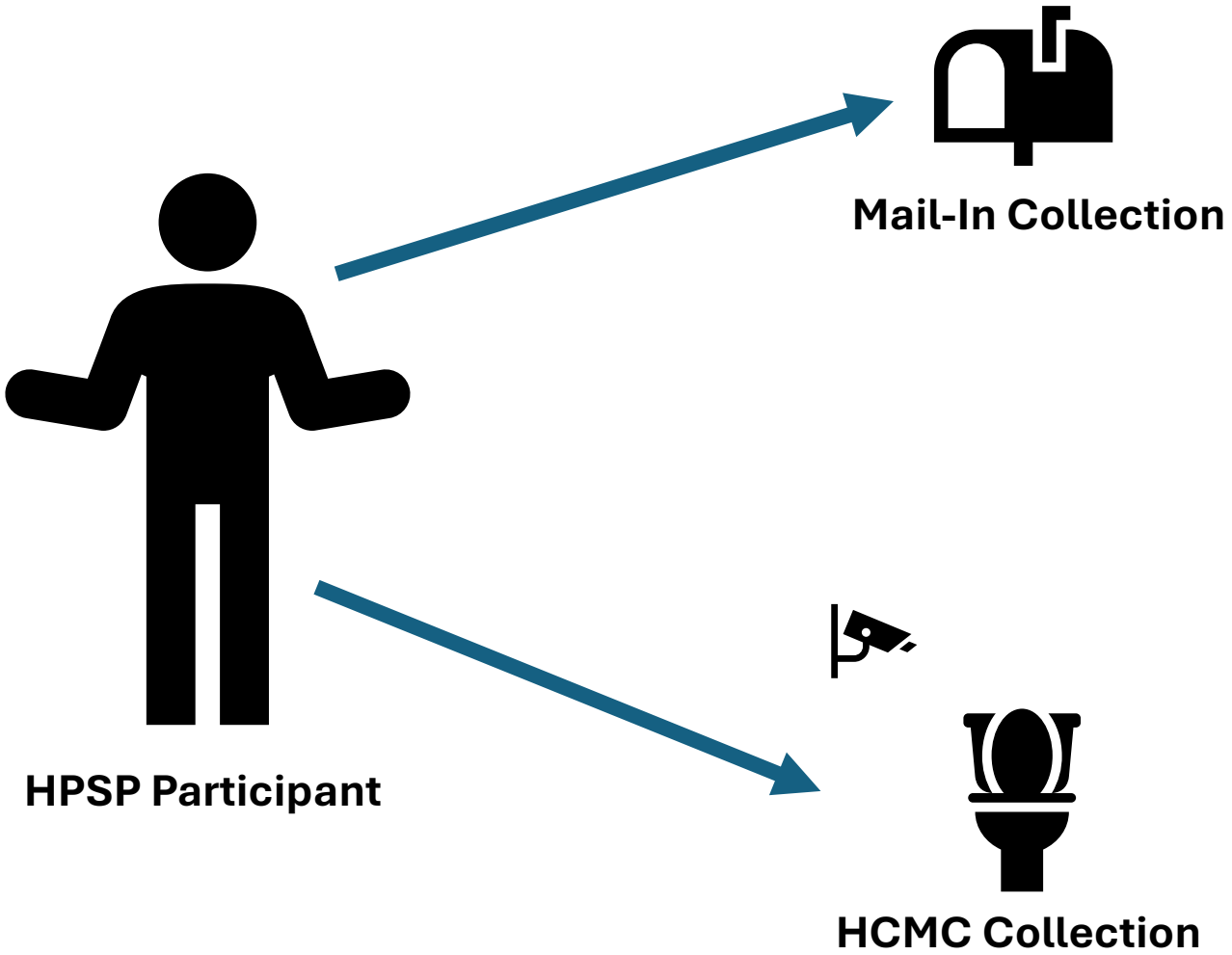
- Staffed 24/7 for emergency toxicology testing by a team of 18+ staff members.
- Supports HHS/HCMC, regional poison center, local hospital systems (e.g., Allina), Hennepin County Office of the Medical Examiner, HPSP, CPS, Juvenile Detention, and more.
- Maintains both clinical and forensic toxicology certification.

The HHS Toxicology Laboratory offers a wide variety of testing.

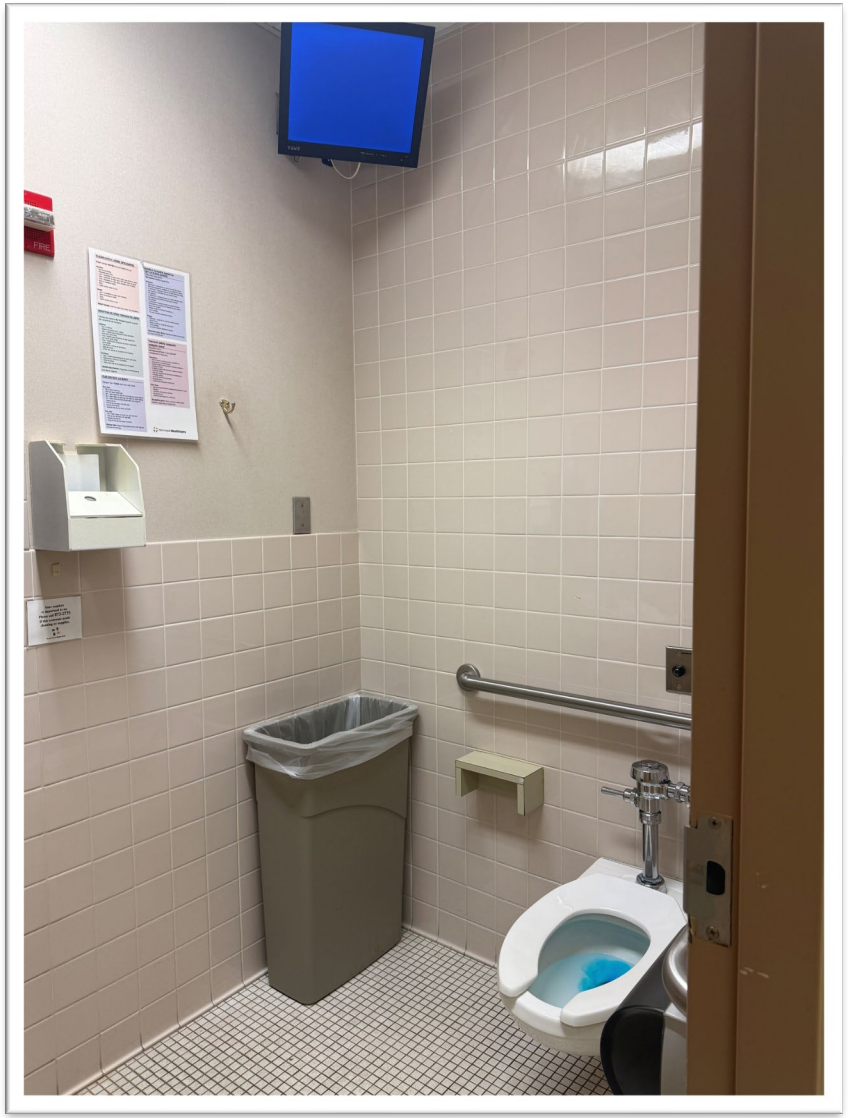
Amphetamines	**Hydrocodone**
Barbiturates	**Opiates**
Benzodiazepines	**Oxycodone**
Buprenorphine	**Propoxyphene**
Cocaine Metabolites	**THC**
Carisoprodol	**Tramadol**
EtG/EtS	**Broad-spectrum drug screen by mass spectrometry***
Ethanol	**PEth****
Fentanyl	

There are 8 panels for HPSP/Board of Nursing that include a combination of the above analytes and other testing available upon request.

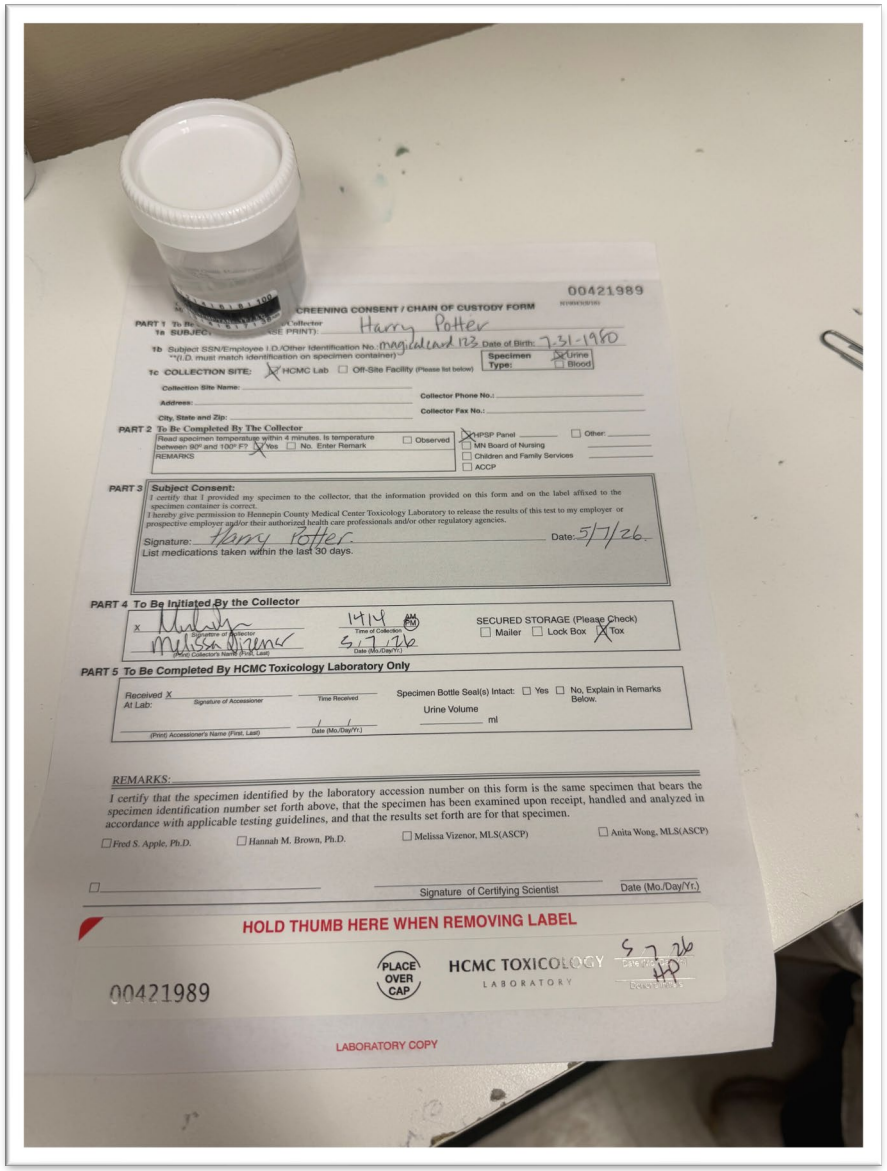
HPSP participants can provide samples by mail or in-person.

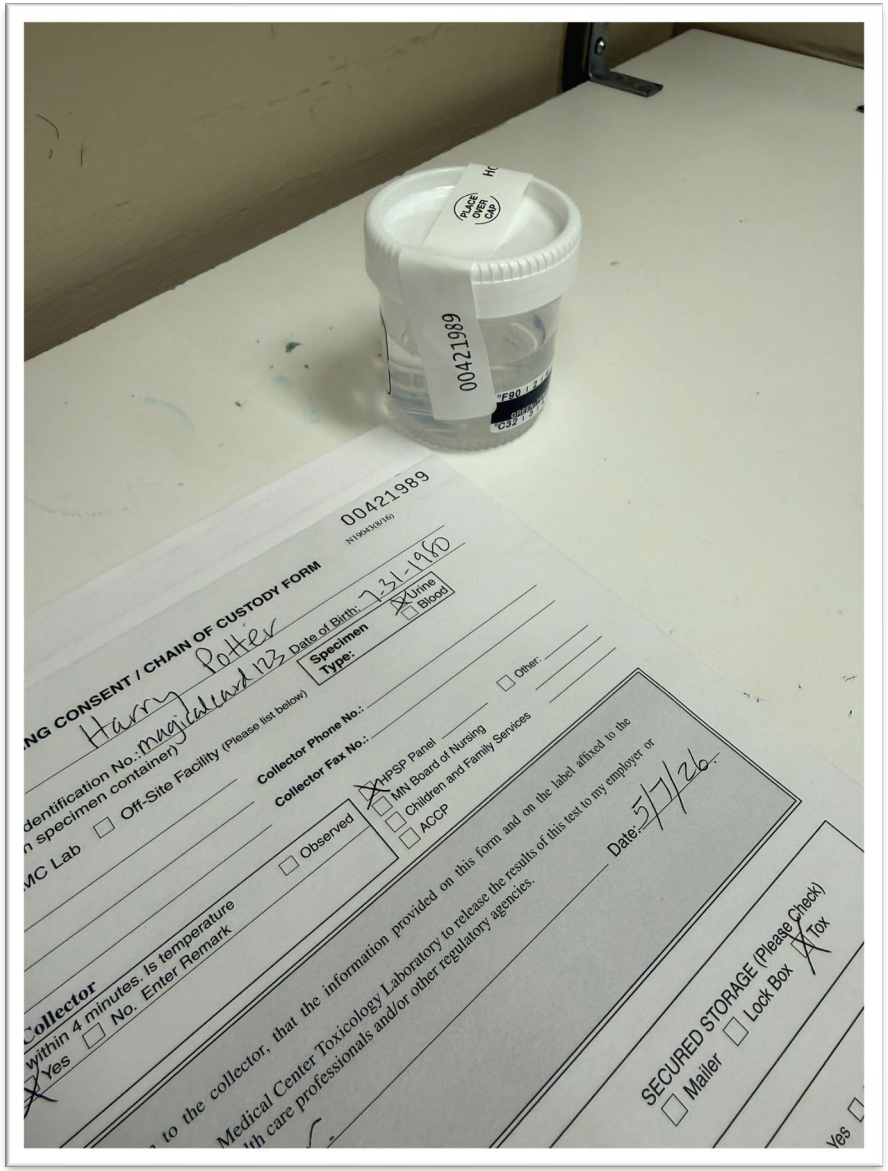


The HHS/HCMC Laboratory is well-equipped for collections.

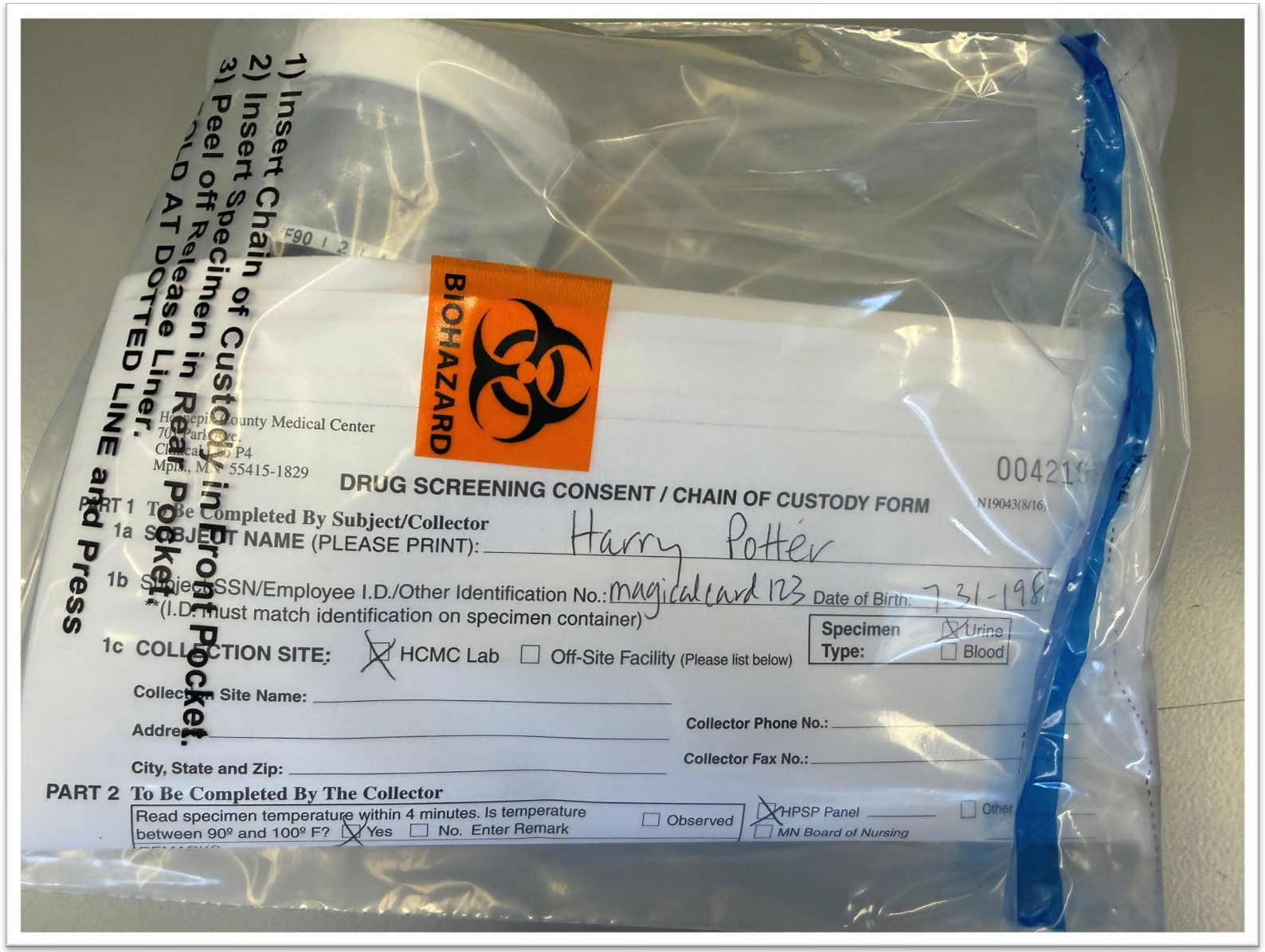


A strict chain of custody is maintained throughout the collection.

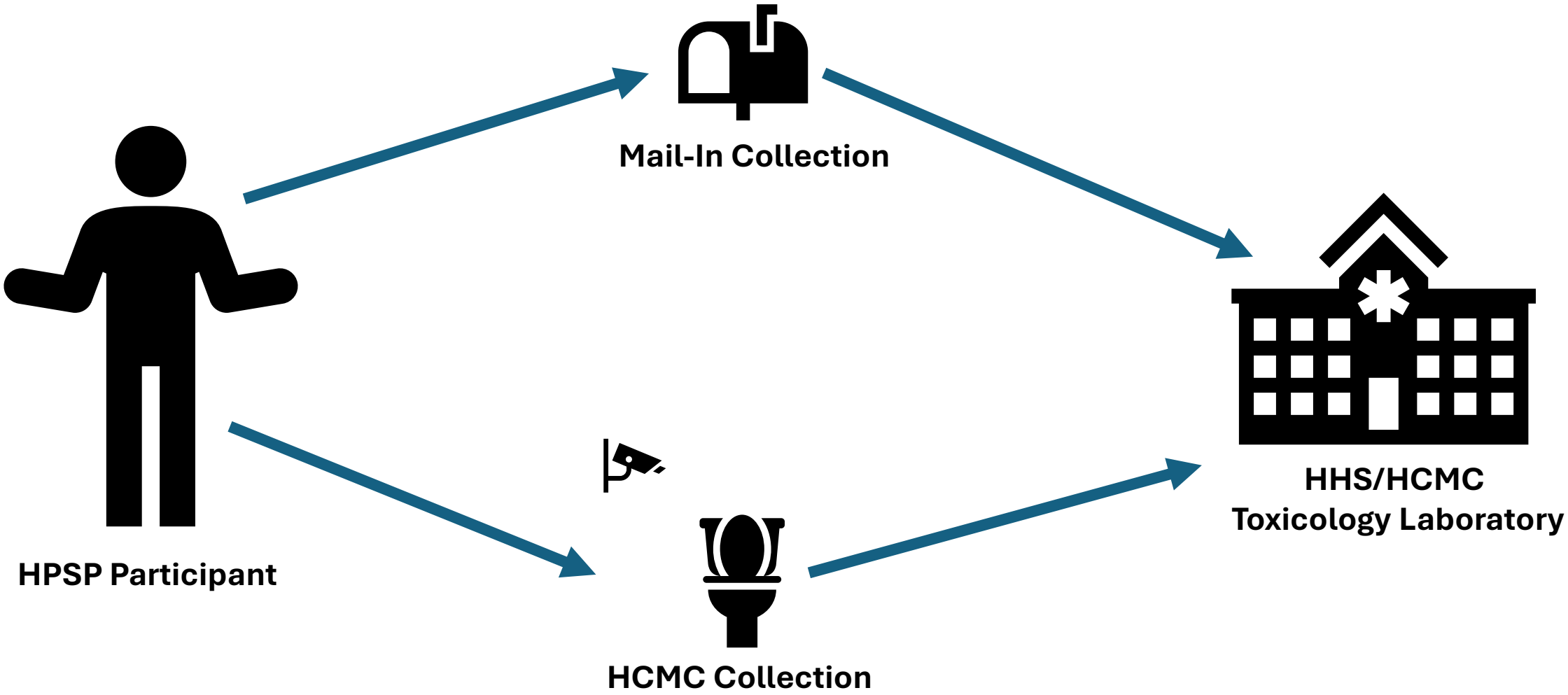




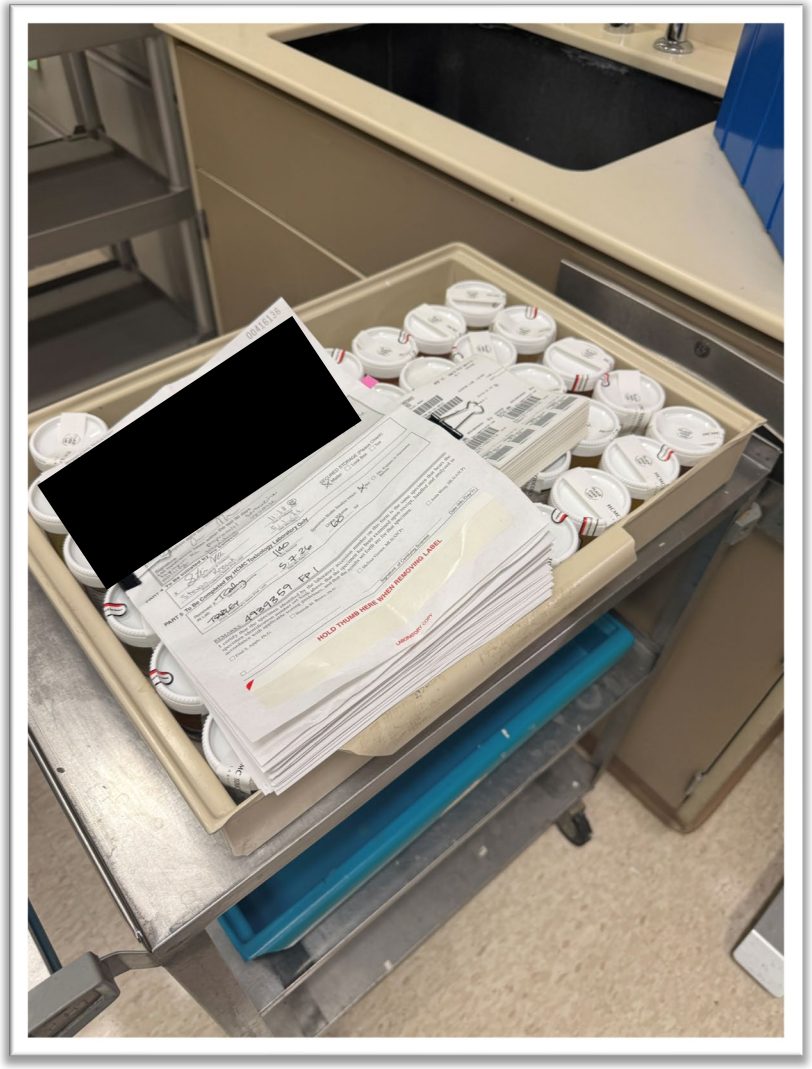
Specimens are sealed in the presence of the participant.

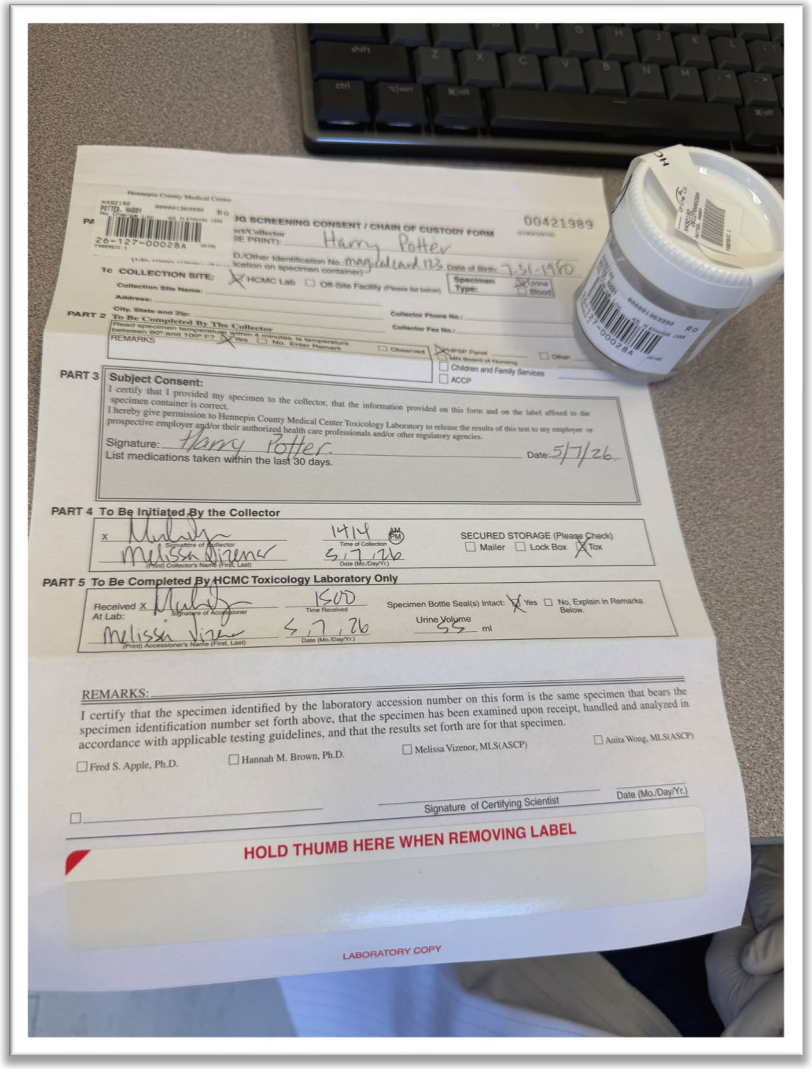


All specimens are received for processing and testing at HHS/HCMC.

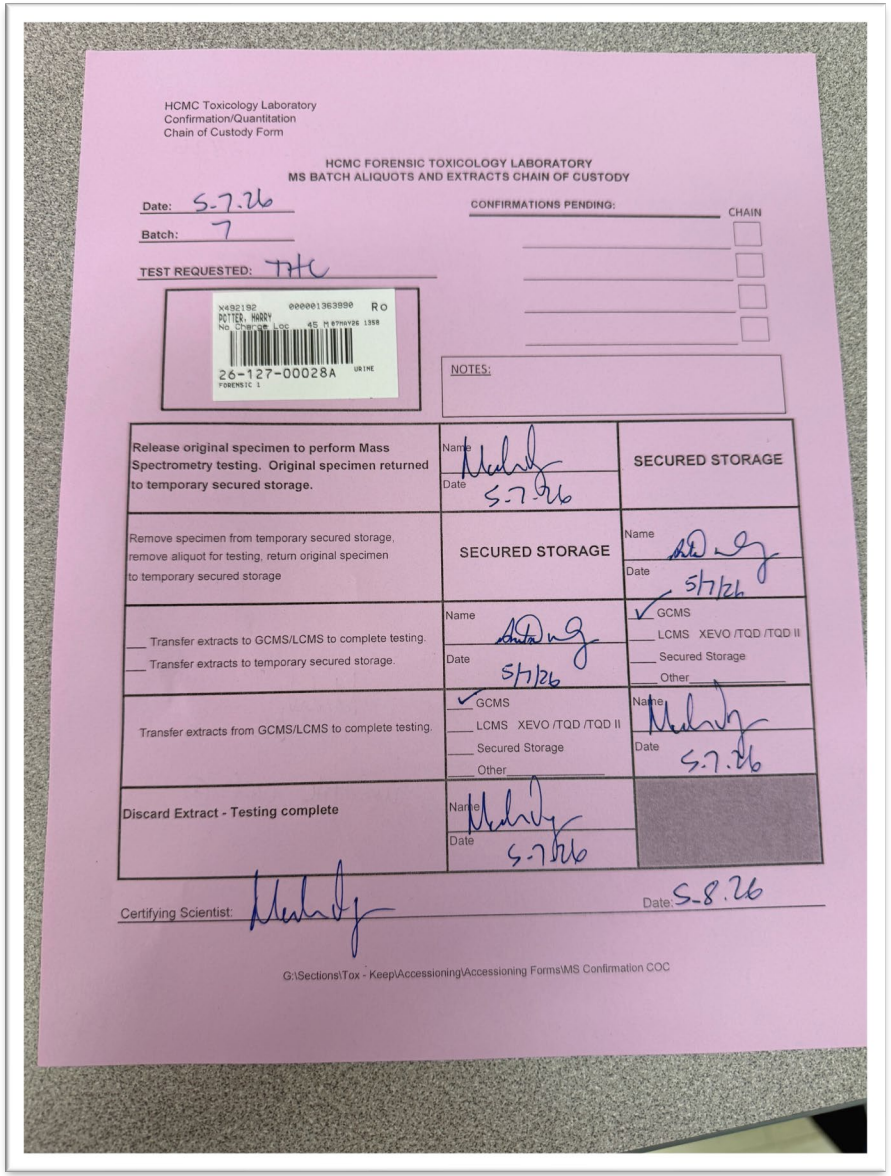


All specimens are received and processed in the toxicology laboratory.





An internal custody chain is maintained throughout the testing process.



HCMC Toxicology Laboratory
Confirmation/Quantitation
Chain of Custody Form

HCMC FORENSIC TOXICOLOGY LABORATORY
MS BATCH ALIQUOTS AND EXTRACTS CHAIN OF CUSTODY

Date: 5-7-26
Batch: 7
TEST REQUESTED: THC
CONFIRMATIONS PENDING:
CHAIN
NOTES:

Release original specimen to perform Mass Spectrometry testing. Original specimen returned to temporary secured storage.	Name / Date 5-7-26	SECURED STORAGE
Remove specimen from temporary secured storage, remove aliquot for testing, return original specimen to temporary secured storage	SECURED STORAGE	Name / Date 5/7/26
___ Transfer extracts to GCMS/LCMS to complete testing. ___ Transfer extracts to temporary secured storage.	Name / Date 5/7/26	✓ GCMS ___ LCMS XEVO /TQD /TQD II ___ Secured Storage ___ Other
Transfer extracts from GCMS/LCMS to complete testing.	✓ GCMS ___ LCMS XEVO /TQD /TQD II ___ Secured Storage ___ Other	Name / Date 5-7-26
Discard Extract - Testing complete	Name / Date 5-7-26	

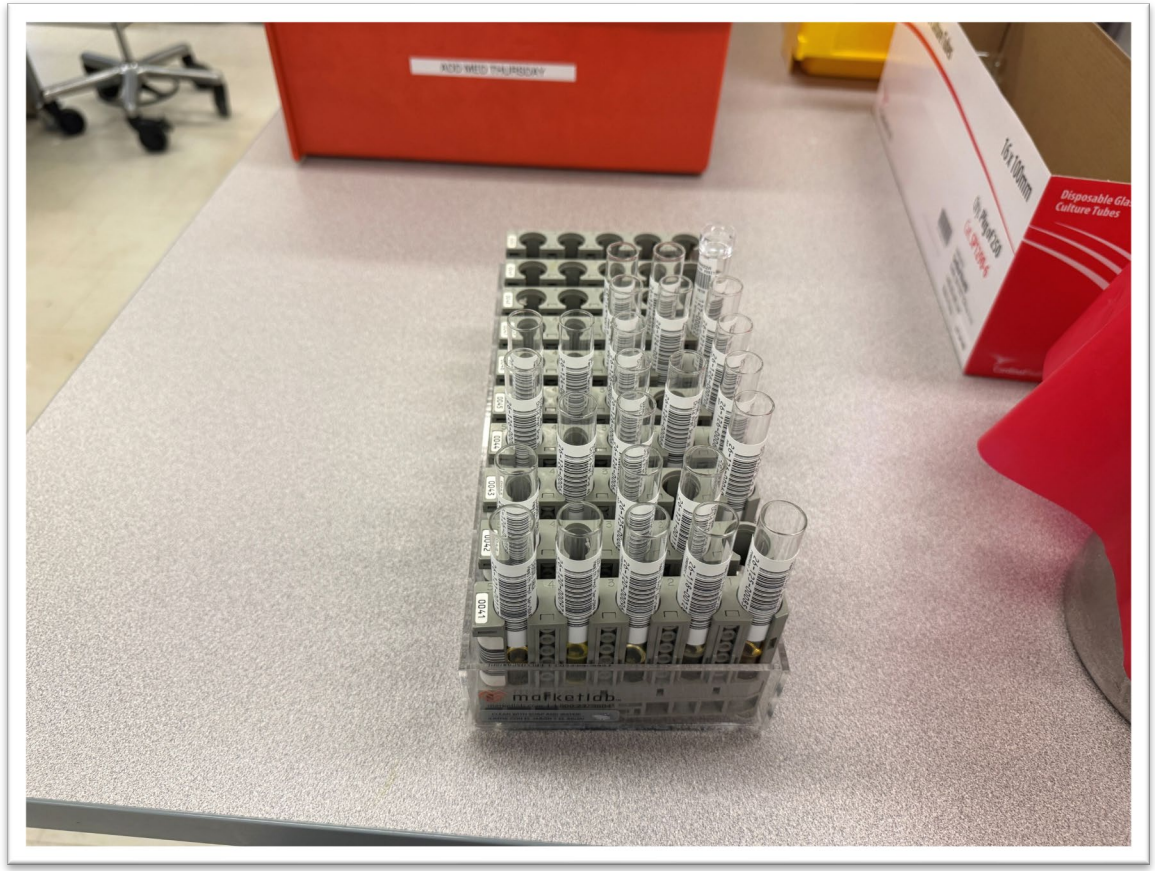
Certifying Scientist: Date: 5-8-26

G:\Sections\Tox - Keep\Accessioning\Accessioning Forms\MS Confirmation COC

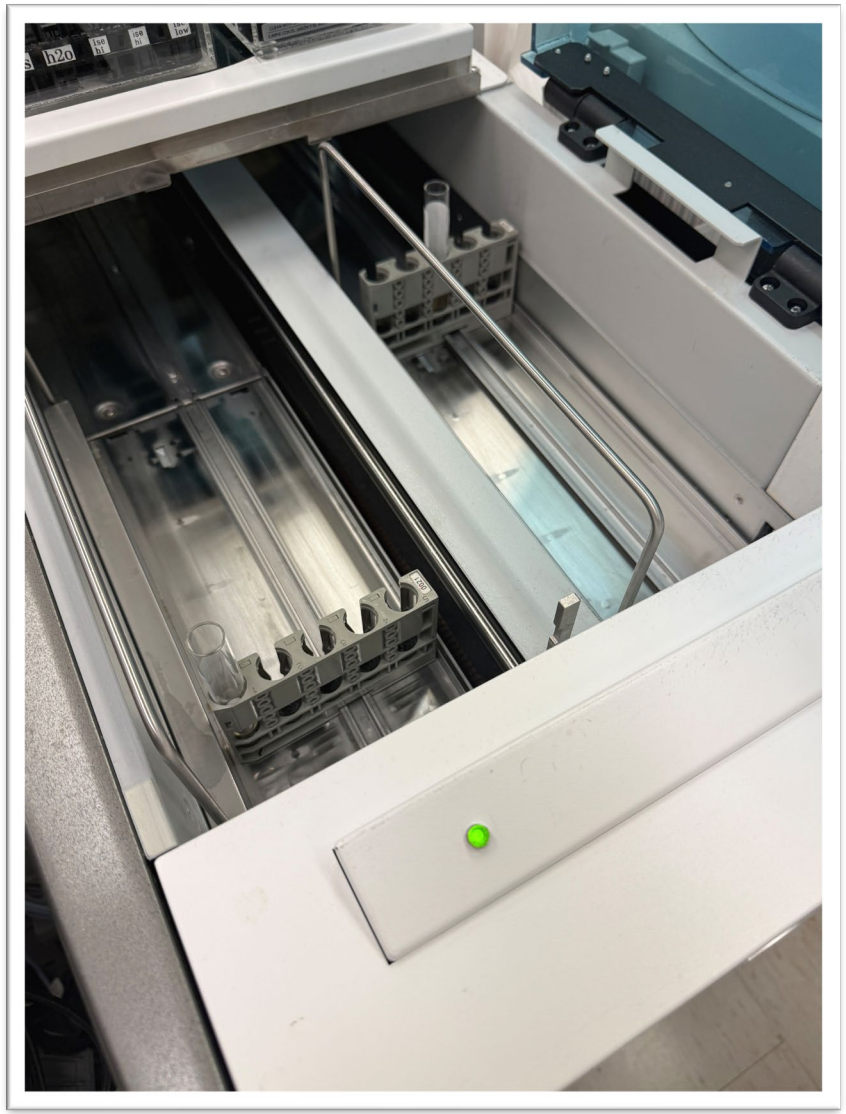
Multiple individuals are involved with the forensic drug testing of each HPSP sample. This is documented on the chain of custody.

All screening and confirmatory results are reviewed by multiple toxicology staff throughout the testing process.

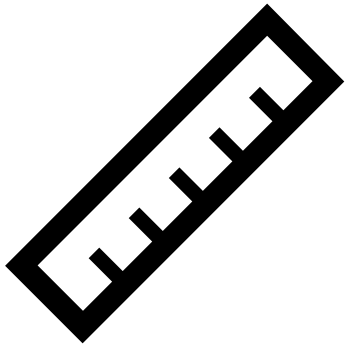
Specimens are first aliquoted for drug screening (IA and MS).



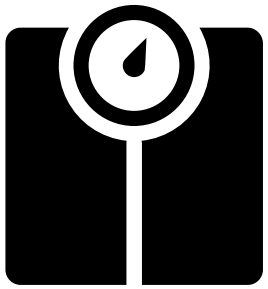
Immunoassay testing is performed on an automated analyzer.



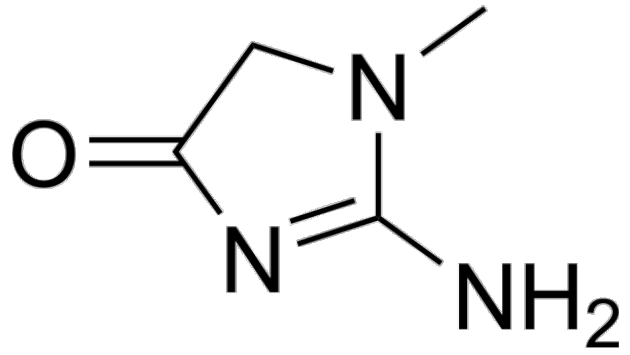
What can we measure to assess specimen integrity?



pH



Specific gravity

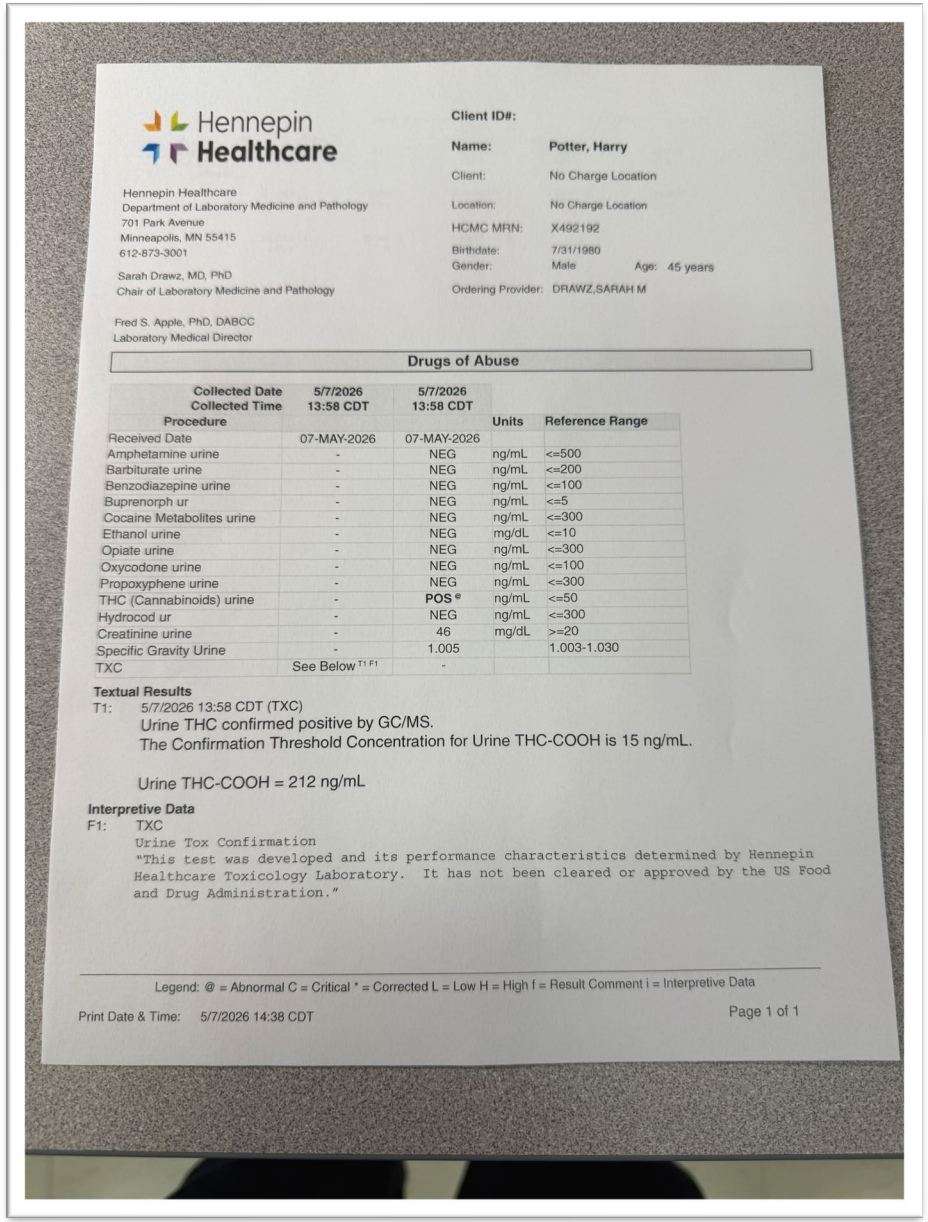


Creatinine

Broad-spectrum drug screens expands number of detectable drugs.

All results are confirmed by LC-MS/MS before reporting.

All results are signed out by a certifying scientist before reporting.



Hennepin Healthcare

Hennepin Healthcare
Department of Laboratory Medicine and Pathology
701 Park Avenue
Minneapolis, MN 55415
612-873-3001

Sarah Drawz, MD, PhD
Chair of Laboratory Medicine and Pathology

Fred S. Apple, PhD, DABCC
Laboratory Medical Director

Client ID#:
Name: Potter, Harry
Client: No Charge Location
Location: No Charge Location
HCMC MRN: X492192
Birthdate: 7/31/1980
Gender: Male Age: 45 years
Ordering Provider: DRAWZ,SARAH M

Drugs of Abuse

Procedure	Collected Date 5/7/2026 Collected Time 13:58 CDT	5/7/2026 13:58 CDT	Units	Reference Range
Received Date	07-MAY-2026	07-MAY-2026		
Amphetamine urine	-	NEG	ng/mL	<=500
Barbiturate urine	-	NEG	ng/mL	<=200
Benzodiazepine urine	-	NEG	ng/mL	<=100
Buprenorph ur	-	NEG	ng/mL	<=5
Cocaine Metabolites urine	-	NEG	ng/mL	<=300
Ethanol urine	-	NEG	mg/dL	<=10
Opiate urine	-	NEG	ng/mL	<=300
Oxycodone urine	-	NEG	ng/mL	<=100
Propoxyphene urine	-	NEG	ng/mL	<=300
THC (Cannabinoids) urine	-	POS @	ng/mL	<=50
Hydrocod ur	-	NEG	ng/mL	<=300
Creatinine urine	-	46	mg/dL	>=20
Specific Gravity Urine	-	1.005		1.003-1.030
TXC	See Below T1 F1	-		

Textual Results
T1: 5/7/2026 13:58 CDT (TXC)
Urine THC confirmed positive by GC/MS.
The Confirmation Threshold Concentration for Urine THC-COOH is 15 ng/mL.

Urine THC-COOH = 212 ng/mL

Interpretive Data
F1: TXC
Urine Tox Confirmation
"This test was developed and its performance characteristics determined by Hennepin Healthcare Toxicology Laboratory. It has not been cleared or approved by the US Food and Drug Administration."

Legend: @ = Abnormal C = Critical * = Corrected L = Low H = High f = Result Comment i = Interpretive Data

Print Date & Time: 5/7/2026 14:38 CDT

Page 1 of 1

Harry Potter confirmed positive for THC at 212 ng/mL.

Toxicology Director Opinions help interpret drug testing results.

- In circumstances in which drug testing results do not match the account provided by the participant, a Toxicology Director Opinion (TDO) can be requested (at an additional cost).
- These written letters provide an interpretation of the participant's drug testing results in the context of an account provided by the participant (includes substances consumed, medications taken, and other relevant details).
- Since August 2024, 35+ TDO's have been written, with an additional two in progress.

Harry Potter claims his +THC was due to second-hand exposure.

- “Honestly, I was as surprised as anyone when the test came back positive for THC. I’ve never used marijuana myself—between classes, Quidditch, and trying not to get killed every other year at Hogwarts, I’ve had quite enough excitement already.
- The most likely explanation is secondhand smoke exposure during Quidditch practice. The Slytherin team was practicing on the adjacent pitch, and a few of them were smoking near the stands before and after training. The smoke kept drifting over toward our side of the field and around the broom shed where we kept our equipment. I spent quite a bit of time there getting my Firebolt ready and helping Madam Hooch set up practice.
- It wasn’t exactly easy to avoid, especially when the wind carried it straight across the pitch. Even with a decent Clearing Charm, smoke has a way of lingering. I was around it often enough that I believe that repeated exposure is what caused the positive result.”

Dr. Brown writes a TDO based on Harry's account.

"The main component of THC (marijuana) is delta-9-THC which is metabolized to carboxy-9-THC, the component eliminated in the urine, that was confirmed definitively by mass spectrometry in Mr. Potter's urine, indicating THC exposure. The scientific literature does not support that exposure to marijuana odors or secondhand smoke in a ventilated area can result in detectable cannabinoid concentrations in urine, even when using a Clearing Charm."

Alternative Matrices

Conventional biological matrices include blood and urine.

Whole Blood

Primary matrix for determining active drug concentrations and degree of impairment.

Plasma & Serum

Separated blood components providing cleaner samples for specific analytical procedures.

Urine

Most commonly used matrix offering longer detection windows for drug metabolites.

These traditional specimens have formed the backbone of forensic drug testing for decades.

Alternative matrices offer advantages.

- Easier, less invasive specimen collection
- Larger detection windows in some cases
- Available when blood specimens are compromised
- Useful for delayed collection scenarios
- Overcome postmortem redistribution issues

Technological advances enable innovation in matrices.

Modern Instruments

Advanced analytical technology with enhanced sensitivity capabilities.

Lower Detection Limits

Ability to detect reduced drug concentrations in alternative specimens.

Expanded Possibilities

Opening new avenues for comprehensive forensic toxicological analysis.

Modern sensitive instruments are revolutionizing the exploration and analysis of alternative biological matrices.

There are a variety of alternative matrices available.

Oral Fluid

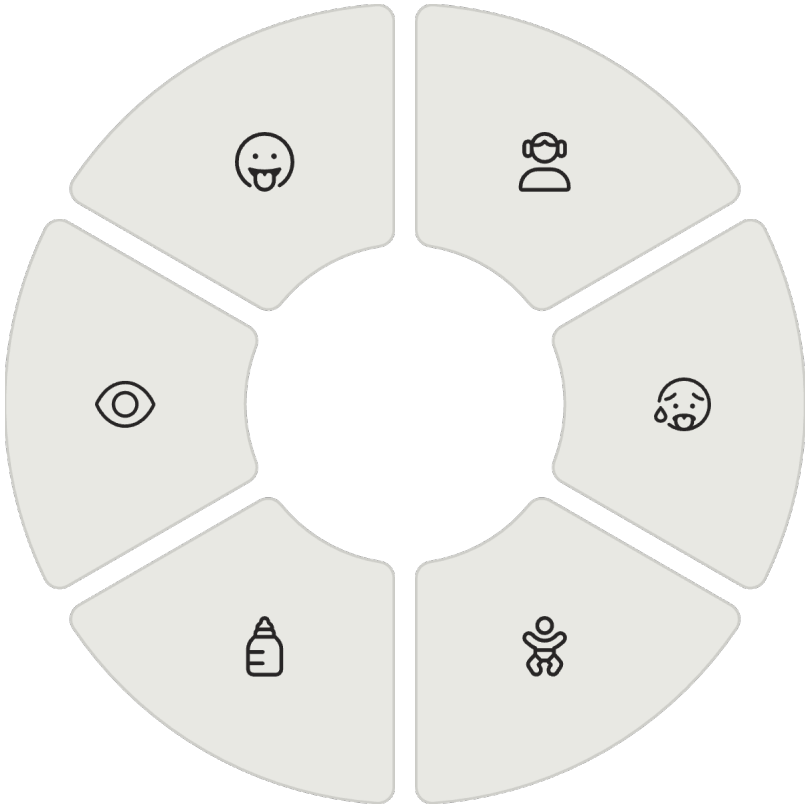
Non-invasive collection with good correlation to blood levels.

Vitreous Humor

Postmortem analysis when blood is unavailable.

Breast Milk

Monitoring drug transfer to nursing infants.



Hair

Extended detection window up to months after use.

Sweat

Continuous monitoring through patch collection systems.

Meconium

Prenatal drug exposure detection in newborns.

There are a variety of alternative matrices available.

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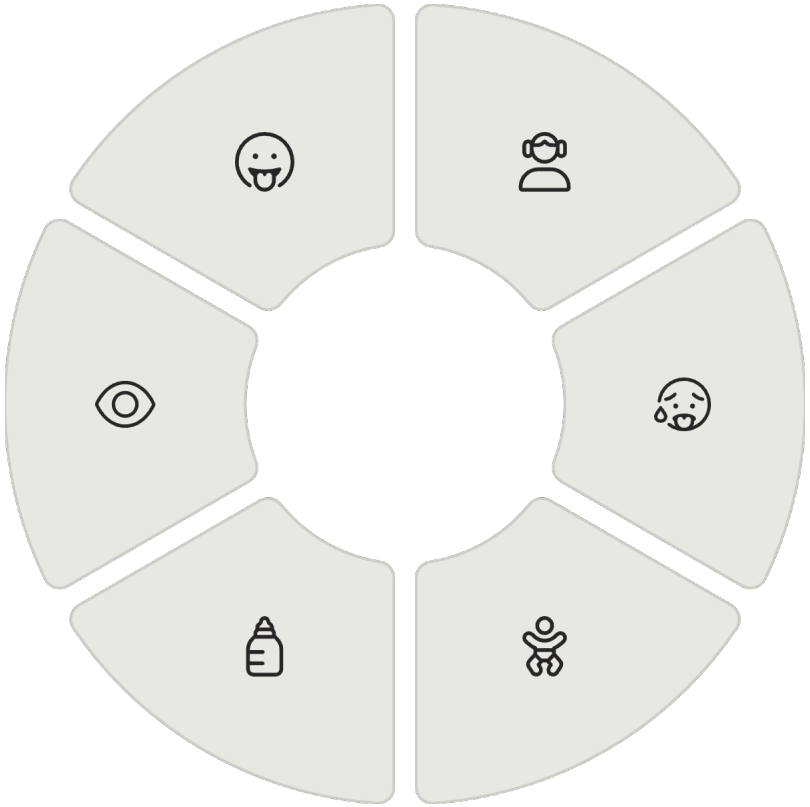

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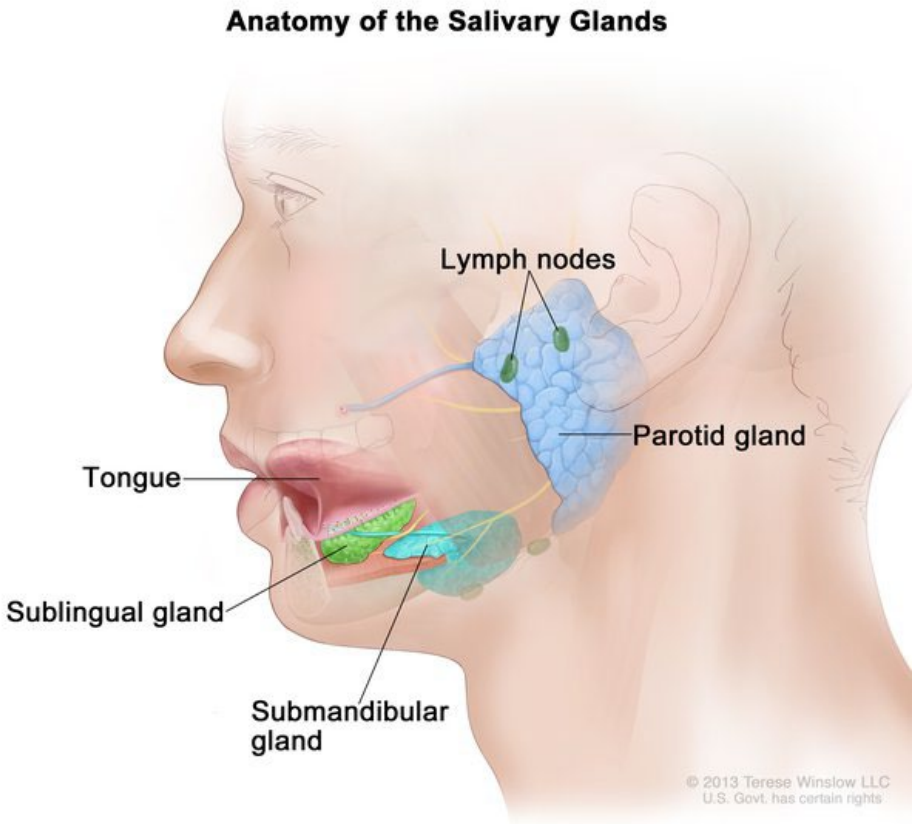
What is oral fluid?



Production

Secreted by three major salivary glands at 0.5-1.5L per day

Composition

99% water plus proteins, cells, bacteria, food debris, and drug traces

Key Difference

Distinct from pure saliva due to additional oral cavity components

How drugs enter oral fluid

01

Blood Filtration

Salivary glands act as direct blood filters due to high perfusion

02

Passive Diffusion

Hydrophobic compounds cross through tissue barriers

03

Ultrafiltration

Low molecular weight hydrophilic substances pass through

04

Ion Trapping

Acidic pH concentrates basic drugs like cocaine and amphetamines

pH Factor: Oral fluid's acidic pH (5.8-6.8) traps weak basic drugs, creating higher concentrations than in blood

Drug concentrations in oral fluid vs urine and blood

Advantages over traditional methods

Non-Invasive Collection

Simple, painless sampling without needles or privacy concerns. No trained medical staff required.

Real-Time Monitoring

Closely reflects free drug plasma concentration, enabling accurate assessment of drug activity levels.

Analytical Accuracy

Simpler matrix with fewer interferences compared to blood and urine can simplify analysis.

Tamper Resistant

Several studies suggest less prone to adulteration risks common with urine collection.

Challenges and limitations

01

Variable Composition

Influenced by circadian rhythm, health status, age, gender, diet, and smoking habits.

02

Contamination Risk

Inhaled or smoked drugs may contaminate oral cavity, affecting interpretation.

03

Limited Volume

Only ~1mL available, requiring highly sensitive detection methods.

Primary applications

Impaired Driving Detection

Screening for cocaine, cannabinoids, amphetamines, benzodiazepines, opiates, and ethanol in suspected DUI cases.

Anti-Doping Testing

Real-time monitoring of 49 prohibited substances including CBD, CBN, heroin, methadone, and fentanyl.

Clinical & Forensic Analysis

Comprehensive drug abuse assessment for legal and medical purposes, especially in anuric patients.

There are a variety of alternative matrices available.

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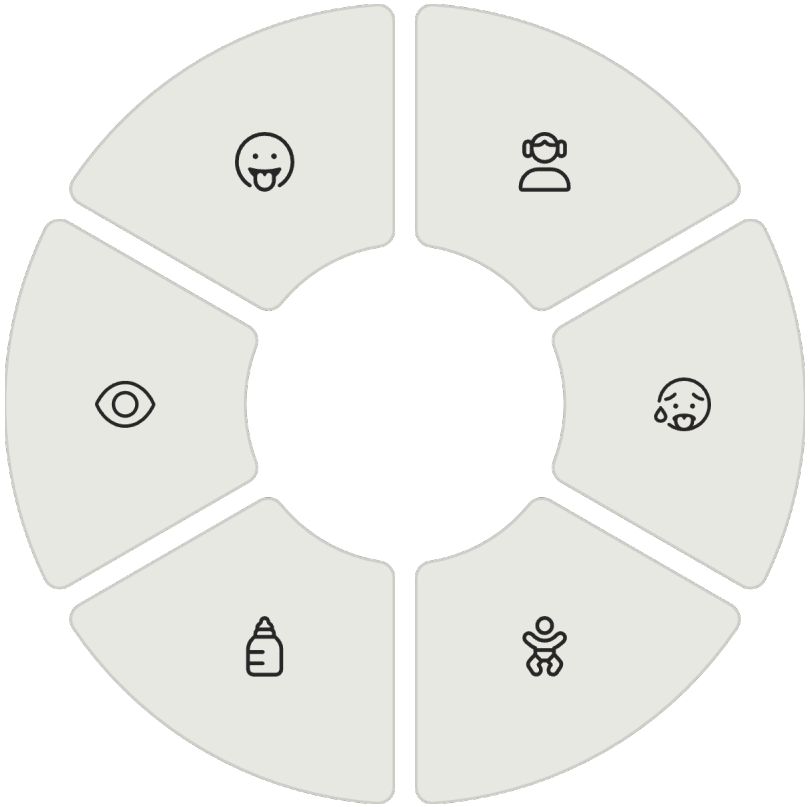
Monitoring drug transfer to nursing infants.



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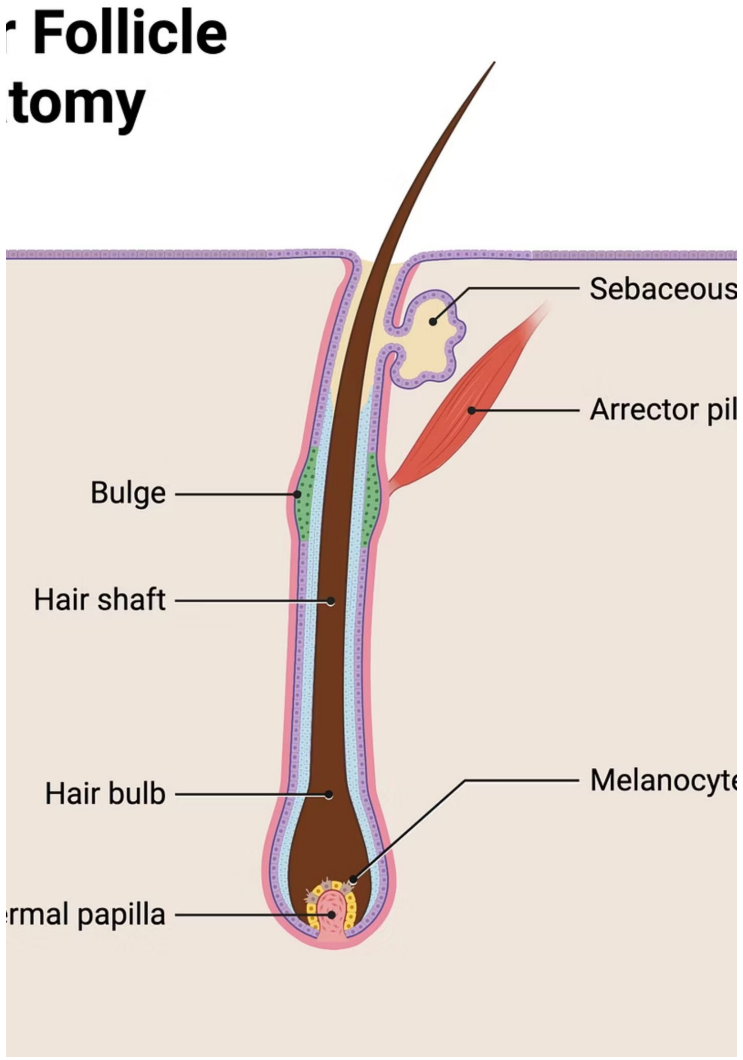
Hair composition & growth



Keratin Structure

65-95% keratin protein forms the hair's primary structure

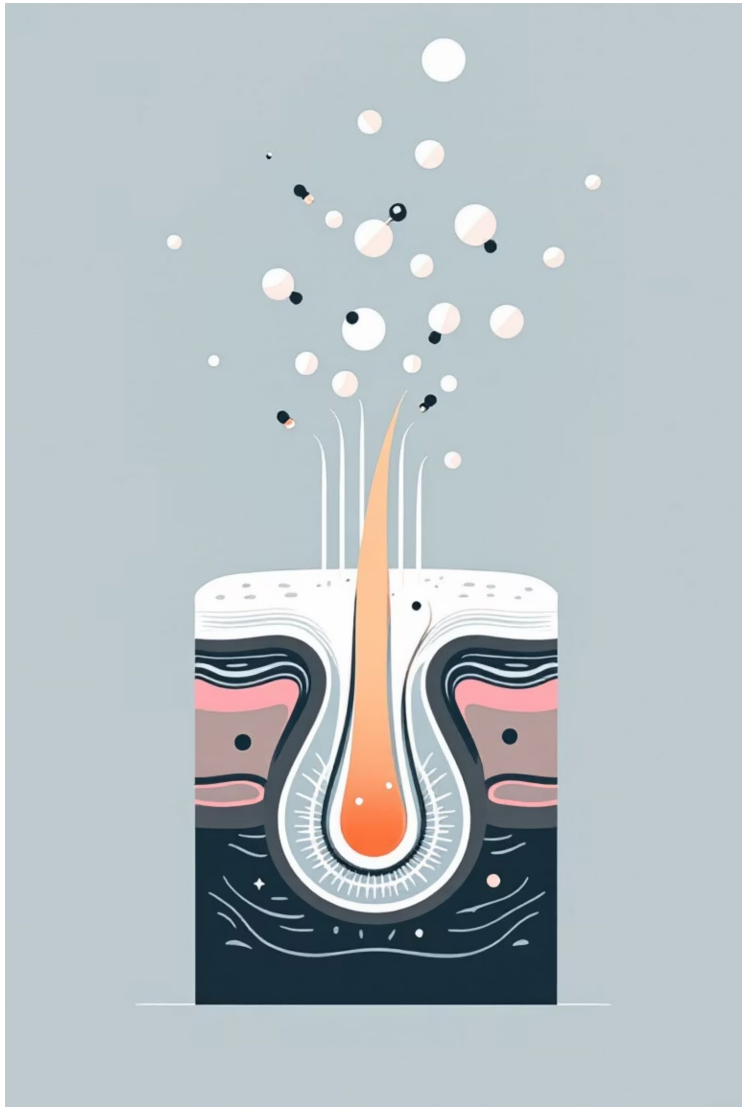
Water Content

15-35% water maintains hair flexibility and health

Growth Rate

0.35mm daily or 1-1.5cm monthly; growth varies by region and ethnicity

Drug incorporation mechanism



1

Blood Diffusion

Drugs enter hair through blood capillaries at the follicle base during active growth

2

Cell Formation

Growing matrix cells incorporate drugs as they elongate and mature into hair fiber

3

External Sources

Additional contamination from sweat, sebum, or environmental exposure

Sample collection

Primary Source

Scalp hair provides the most reliable samples for analysis when sufficient length is available.

Alternative Sites

- Pubic region
- Arms and armpits
- Facial hair (beard)

Factors affecting drug deposition

Hair Characteristics

- Melanin content - darker hair binds more drugs
- Ethnic origin influences binding capacity
- Growth rate varies by body region

Drug Properties

- Lipophilic molecules incorporate better
- Basic compounds show higher affinity

Dark pigmented hair binds alkaline drugs like cocaine and codeine more effectively due to melanin's hydrophobic nature.

Environmental impact on results

Chemical Treatments

Bleaching, perming, and dyeing can reduce drug concentrations through strong alkaline exposure

Natural Factors

Sunlight, weather, and pollution damage hair cuticles and affect drug stability

Photodegradation

UV exposure creates free radicals that break down drug compounds over time

Advantages of hair testing

Extended Detection

Standard detection of 90-day drug history versus hours to days for other sample types

Non-invasive

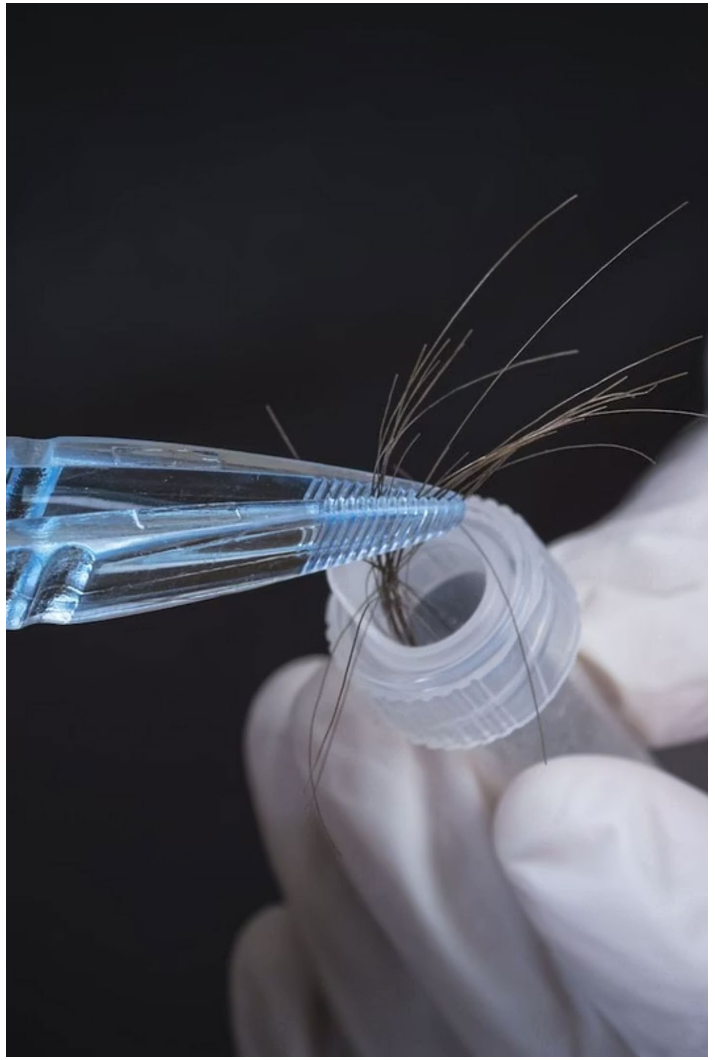
Easy collection without privacy concerns or infection risk

Stable Storage

Durable structure allows long-term preservation and transport

Chronic Use Patterns

Segmental analysis reveals usage timeline and frequency



Limitations

Recent Use Gap

Cannot detect drug use within 7 days due to growth cycle delay

Technical Complexity

Requires sensitive GC-MS or LC-MS confirmation methods, increasing costs

Interpretation Challenges

Complex incorporation variability makes result analysis difficult without standardized protocols

ⓘ The Society for Hair Testing (SOHT) provides guidelines to standardize collection, testing, and reporting procedures.

Primary applications

Workplace Testing

Employee drug screening for safety-sensitive positions

02

Criminal Investigation

Drug-facilitated crimes and postmortem toxicology cases

03

Child Custody

Parental drug use assessment in family court proceedings

04

Treatment Monitoring

Abstinence verification during rehabilitation programs

Hair analysis provides crucial historical drug exposure data when other biological samples are unavailable.

New Drugs of Interest

Adding new drugs of interest is not a simple process.

- Adding a new drug to testing is not as simple as “flipping a switch?”. Each analyte requires an extensive method validation.
- If screening is performed by immunoassay, a new assay must be developed, validated, and maintained for reliable detection.
- If immunoassay is not available, confirmatory testing by mass spectrometry requires certified reference standard material to accurately identify and compare results. We do not report presumptive positives without confirmation to ensure accuracy and avoid false positives.
- Confirmatory testing may not be available in-house and, for some drugs, may not be available at all due to lack of validated methods or reference materials.
- When an external reference laboratory is required, turnaround time can extend from weeks to months, with significant additional send-out costs to the patient and health system.

A recent request for tianeptine demonstrates this point.

- We can detect on our broad-spectrum mass spectrometry screen but we would need to confirm it before reporting. This may be challenging, as it is an illicit substance in the US and pharmacy standards are not readily available.
- To our knowledge, there is only one laboratory that offers confirmatory testing and the price for this testing could exceed $200. Since the confirmatory testing would be a sendout test, the turnaround time could be up considerable (weeks to a month).

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