Fundamentals of Urine Drug Testing and Interpretation

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Objectives

- Review the differences between screening and confirmatory testing
- Review the components and limitations of urine drug testing
- Practice test interpretation through case-based discussion

Fundamentals of Drug Testing

- Tool that provides information on individual's substance use
- Decision to use based on:
  - Patient care
  - Outcomes
- Evidence in addiction treatment limited
- Potential to improve outcomes if used consistently and correctly to monitor and adjust treatment plans

Presumptive Test

- AKA:
  - Qualitative
  - Preliminary
  - Point of care testing
  - Screen
- Rapid results
- Lower sensitivity/specificity

Definitive Testing

- AKA:
  - Confirmatory
  - Chromatography/mass-spectrometry
  - Quantitative
- Slower turnaround
- Highly sensitive/specific
  - Detect specific substance
  - Measure quantity of substance

Laboratory Testing

- “Gold Standard”
- Greater accuracy/precision
- EIA → Presumptive, Qualitative
- LCMS → Definitive, Quantitative
- Delayed results

Point Of Care Testing

- Qualitative/Presumptive
- Done in office → rapid results
- Economical
- Lower accuracy/precision vs. laboratory testing
- Staff need training to interpret

Testing Outcomes

	Drug Present	Drug Not Present
Test Positive	**True Positive**	**False Positive**
Test Negative	False Negative	True Negative

Testing Detection Windows

	Minutes	Hours	Days	Weeks	Months
Blood					
Breath					
Oral Fluid					
Urine					
Sweat					
Hair					

Adapted from SAMSHA [5]

Blood Drug Testing

- Allows precise measurement of drug concentration levels (parent compound)
- Detection window = 1-48 hours (usually <24 hours)
- Used in emergency situations most often
  - Assess impairment/degree of intoxication
  - Commonly use to test for alcohol use
- Advantages:
  - Determine acute impairment/intoxication
  - Resistant to tampering
- Disadvantages:
  - Invasive
  - Need staff training in phlebotomy
  - Limited use outside of determining acute impairment/intoxication

Breath Drug Testing

- Detects drugs in exhaled breath from aerosolized particles in fluid lining the lungs
- Breath alcohol concentration used to estimate blood concentration
- Detection window = ~1 hour per standard drink
- Primarily used to detect/quantify recent alcohol use
- Advantages:
  - Less invasive
  - Resistant to tampering
- Disadvantages:
  - Contamination from food/oral hygiene products with alcohol
  - Limited utility outside of detecting recent alcohol use (tests for other substances in development)

Oral Fluid Drug Testing

- Passive diffusion of drugs from bloodstream to salivary glands + excretion by mucous membranes during inhalation/ingestion
  - Generally correlates to plasma concentrations (unless consumed orally)
  - May be used to detect parent drug presence and impairment
- Uses collection pad/sponge placed in oral cavity
- Detection window = 12 to 48 hours

Oral Fluid Drug Testing

- Advantages:
  - Less invasive collection process
  - More likely to find parent drug compound
  - Sample diversion reduced
- Disadvantages:
  - Sample contamination from eating/smoking
  - Shorter detection window vs. urine testing
  - Not as well studied/established compared to urine testing

Urine Drug Testing

- Metabolites excreted in the urine
  - 2 hours after use to be detected
- Detection window = 1-3 days, can be longer
- Advantages:
  - Well-established technology
  - Rapid results
  - Less expensive
- Disadvantages:
  - Sample tampering → substitution, adulteration and dilution
  - Invasive and resource intensive with observed collections

Sweat Drug Testing

- Mechanism of how drugs enter sweat poorly understood
- Sweat collected continuously by a pad or patch worn on skin
- Detection window = 1-2 weeks typically, up to 4
- Advantages:
  - Wide detection window
  - Passive collection, less invasive
- Disadvantages:
  - Newer technology, little research
  - Insufficient evidence to support use in addiction medicine (currently)

Hair Follicle Testing

- Absorbs compounds as blood passes through hair follicle/sweat gathers at base
- Continuous collection
- Hair takes ~8 days to grow from follicle to scalp
- Chemical treatments can affect results

Hair Follicle Testing

Advantages

- Long detection window – 90 days
- Reduced tampering

Disadvantages

- Expensive
- Variability based on hair's characteristics (pigmentation, texture, porosity) → potential for discrimination
- Passive external contamination
- Process not standardized/less established than urine drug screening

	Blood	Breath	Oral Fluid	Urine	Hair	Sweat
Detection Period	1-48 hours Typically <24 hr	~1 hr per standard drink	1-48 hours	1-4 days	7-100 days	Continuous, usually 1-4 weeks
On-Site Testing/POCT	Yes, primarily for alcohol	For alcohol	Yes	Yes	No	No
Primarily Detects	Parent drug compound: blood alcohol concentration	Parent drug compound: blood alcohol concentration	Parent drug compound	Drug metabolite	Parent drug compound	Parent drug compound
Use in Treatment	Determine acute impairment and intoxication for alcohol	Determine acute impairment and intoxication for alcohol	Short-term detection	Intermediate-term detection	Long-term monitoring; 3-month drug use history	Medium-term prospective monitoring
Ease of Collection	Requires trained phlebotomist	Easy	Easy	Requires bathroom	Easy	Easy
Resistance to Tampering	High	High	High	Low	High *unless chemically treated	High, some uncertainty
Ability to retest sample	Difficult	Generally not possible	Difficult	Possible	Possible	Easy

Adapted from American Society of Addiction Medicine. Appropriate use of drug testing in clinical addiction medicine. 2017.

Case #1

26 yo G2P2 female with a history of opioid use disorder undergoes urine drug screening for an open DSS case. Results of the screen show the following results. You review the test with the patient who denies use of any opioid. What next?

	Lab Results	Cutoff (ng/ml)
Opiates (IA)	Positive	50
Benzodiazepines (IA)	Negative	200
Amphetamines (IA)	Negative	1000
Methadone (IA)	Negative	50
Methadone Metabolite/EDDP (IA)	Negative	50
Cocaine (IA)	Negative	50
THC (IA)	Negative	50
Buprenorphine (IA)	Negative	10
Fentanyl (IA)	Negative	10
Barbituates (IA)	Negative	50
Oxycodone (IA)	Negative	50

Case #1

The patient returns to discuss f/u testing. How do you interpret these results for the patient?

She continues to deny any substance misuse and asks if there is any other potential explanation for these results.

OPIATES	Lab Results	ng/ml	Cutoff (ng/ml)
Opiates (IA)	Positive	>800	50
Codeine (MS)	Positive	360	50
Morphine (MS)	Positive	859	50
Hydrocodone (MS)	Negative	0	50
Hydromorphone (MS)	Negative	0	50
Oxycodone (MS)	Negative	0	50

Case #1

- Poppy seed consumption
- Morphine to codeine ratio = >2:1 (typically)
- Study of volunteers demonstrating codeine only positive screens following consumption
- Poppy seeds
  - *Papaver somniferum*
  - Do not contain opiates; contaminated via poppy latex

OPIATES/OPIOIDS

- Standard opiate assay
  - Morphine
  - Codeine
  - Heroin
- May detect hydrocodone/hydromorphone
- Need specific assays for other semi-synthetics/synthetic opioids

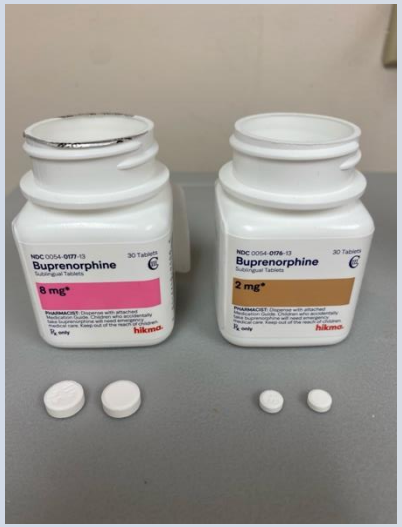
OPIOIDS

OPIATES

Opium poppy
- Morphine
- Codeine
- Thebaine

SEMI-SYNTHETICS

Hydrocodone
Oxycodone
Buprenorphine



SYNTHETICS

Methadone
Fentanyl

Case #2

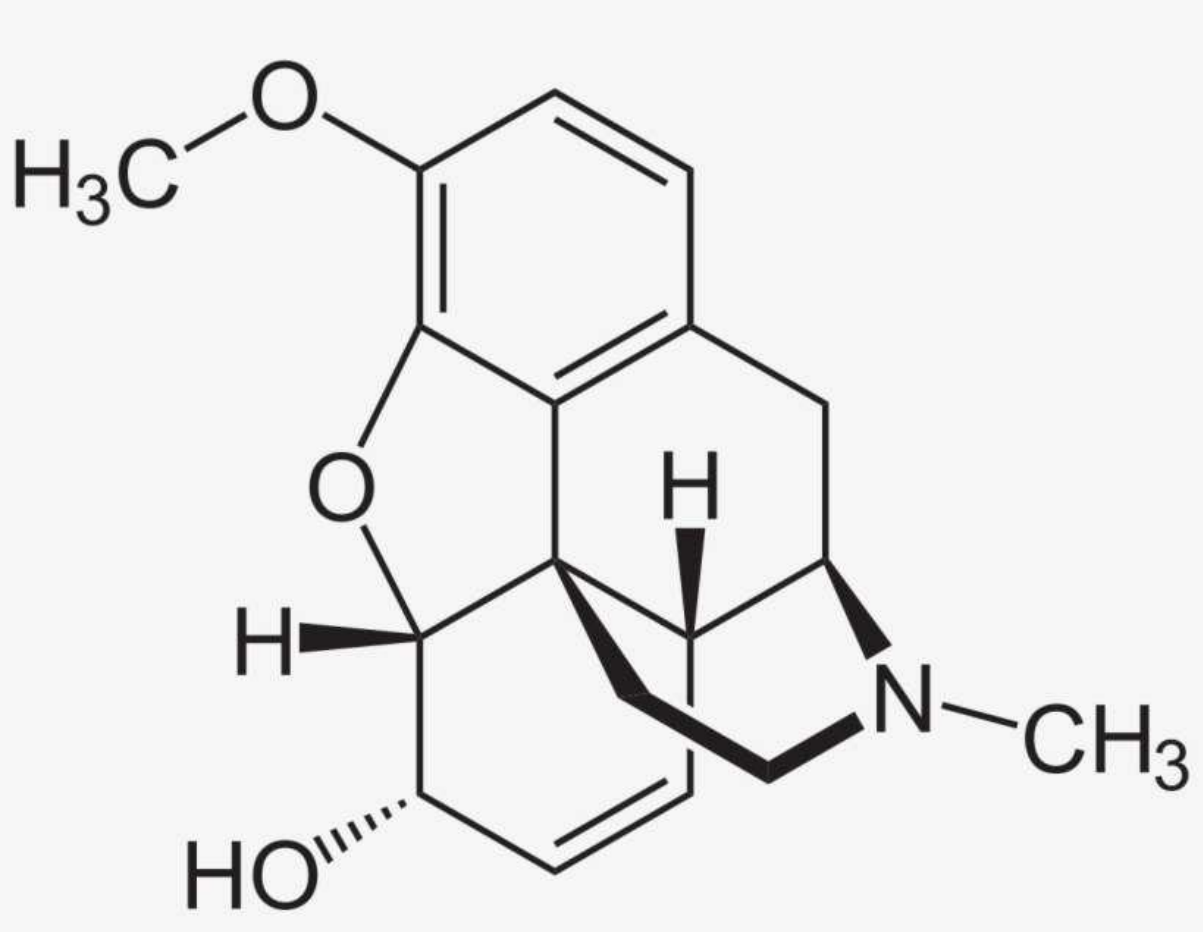
34 yo female presents for OBOT recheck. She reports recent dental visit for dental abscess and was given something for pain and an antibiotic. PDMP shows prescription for acetaminophen-codeine, #8 filled last week. Today, on testing UDS is positive for BUP/OPI/MOP. Confirmatory testing was sent.

OPIATES	Lab Results	ng/ml	Cutoff (ng/ml)
Opiates (IA)	Positive	400	50
Codeine (MS)	Positive	308	50
Morphine (MS)	Positive	117	50
Hydrocodone (MS)	Positive	28	50
Hydromorphone (MS)	Negative	0	50
Hydrocodone (MS)	Negative	0	50

Expected or Unexpected?

CODEINE

- Prodrug
- CYP2D6 metabolism → morphine (MOP)
  - Poor metabolizer = no/low MOP
  - Rapid metabolizer = ↑ MOP
- Up to 11% metabolized to hydrocodone by unknown mechanism



Case #3

48 yo male presents for f/u at OTP to discuss recent urine drug testing. He reports being stable on his current methadone dose of 115 mg daily and denies any recent substance misuse. Patient does state he went to an ER while on vacation last week after falling and injuring his back. He was given a “shot for pain” and discharged home.

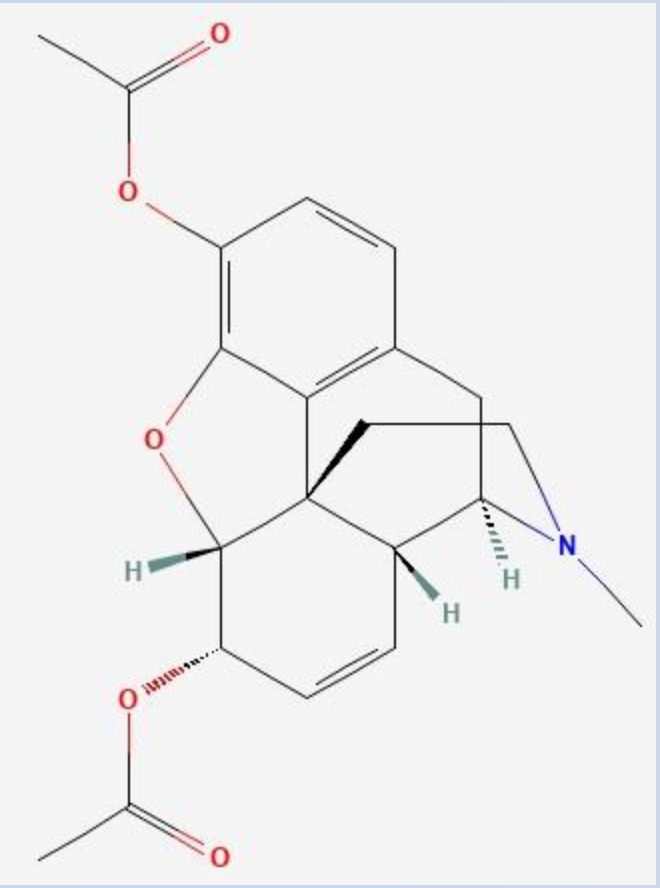
- Presumptive or Definitive?
- Interpretation?

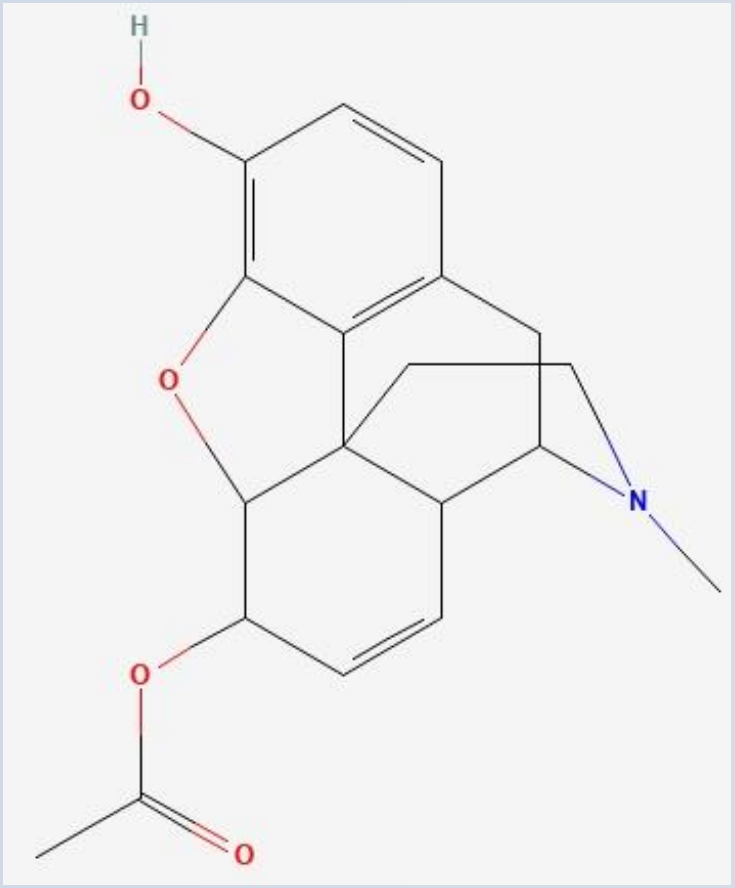
Opiate/Opioid					
Buprenorphine	Confirm		ND	2.5	CONSISTENT
Norbuprenorphine	Confirm		ND	10	CONSISTENT
Methadone	Confirm	2244	POS	50	INCONSISTENT
EDDP	Confirm	1726	POS	50	INCONSISTENT
Norcodeine	Confirm		ND	50	CONSISTENT
Codeine	Confirm		ND	50	CONSISTENT
Morphine	Confirm	1701	POS	50	INCONSISTENT
Hydrocodone	Confirm		ND	50	CONSISTENT
Hydromorphone	Confirm		ND	50	CONSISTENT
Norhydrocodone	Confirm		ND	50	CONSISTENT
6-Acetylmorphine	Confirm	84	POS	25	INCONSISTENT
Oxycodone	Confirm		ND	50	CONSISTENT
Noroxycodone	Confirm		ND	50	CONSISTENT
Oxymorphone	Confirm		ND	50	CONSISTENT
Noroxymorphone	Confirm		ND	50	CONSISTENT
Normeperidine	Confirm		ND	50	CONSISTENT
Naloxone	Confirm		ND	10	CONSISTENT
Sedative/Hypnotic					
Ethyl Glucuronide	Confirm		ND	250	CONSISTENT
Ethyl Sulfate	Confirm		ND	150	CONSISTENT

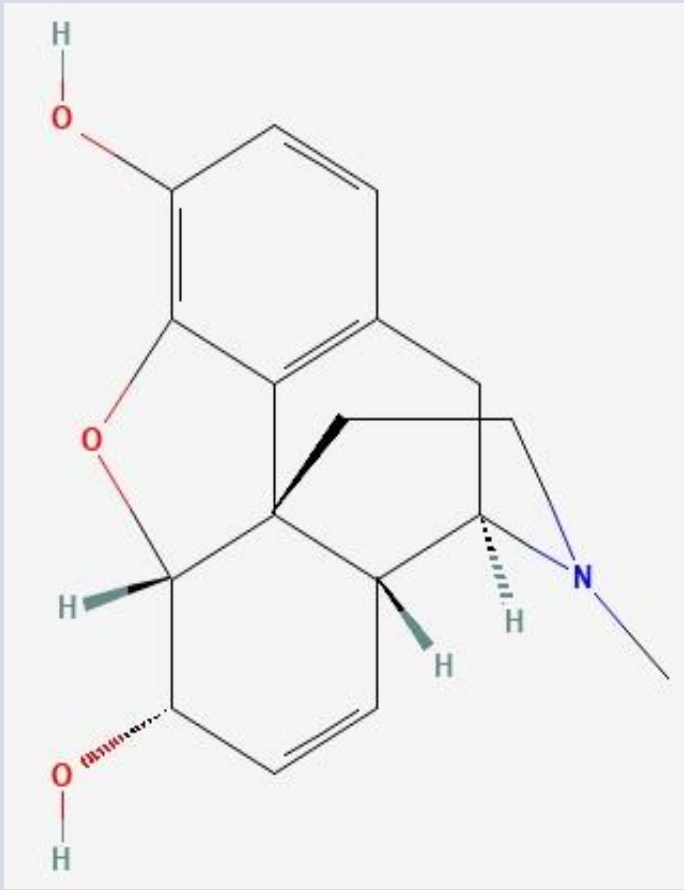
HEROIN

6 – MONOACETYL MORPHINE

MORPHINE





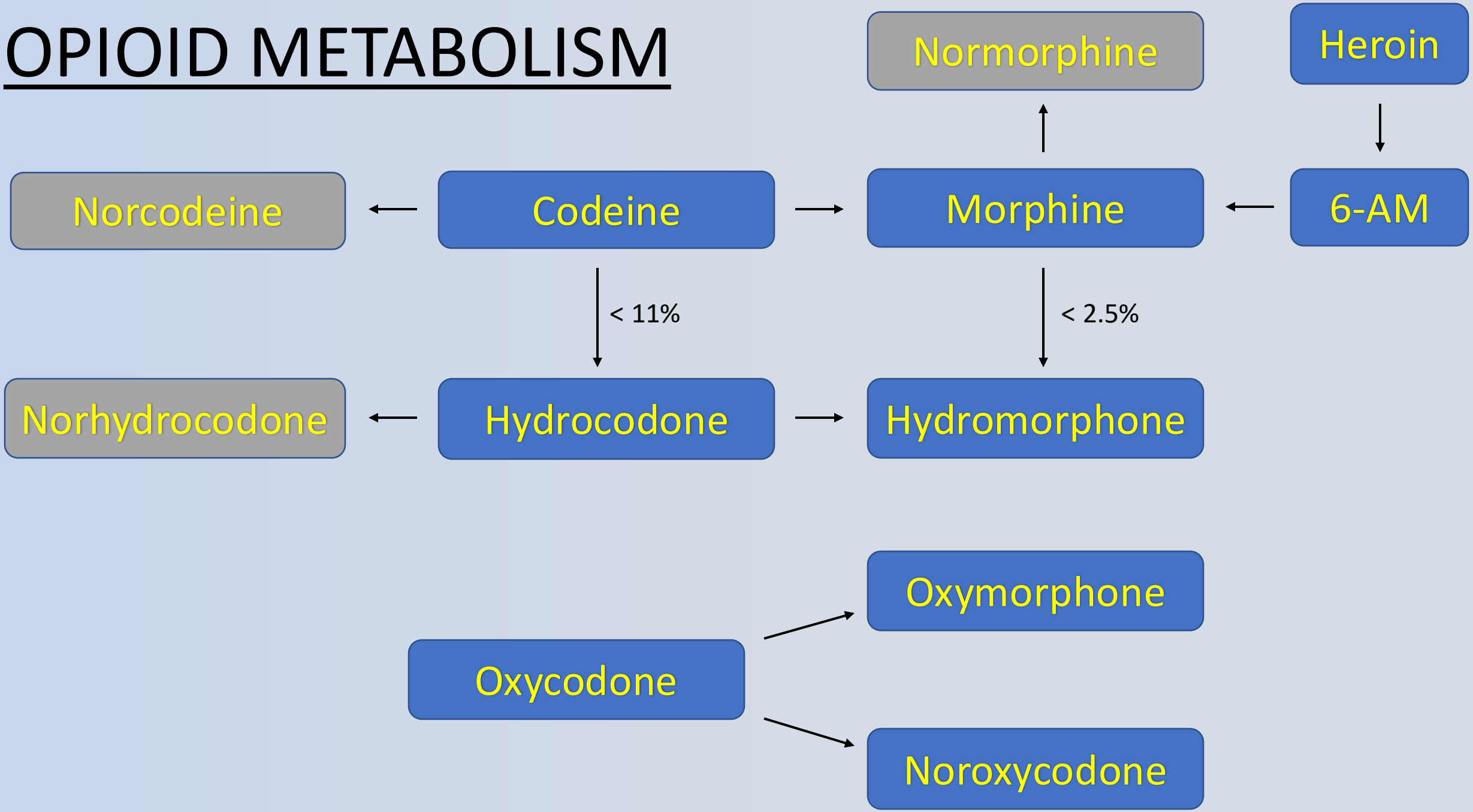


Case #4

56 yo female with history of chronic back pain is prescribed MS Contin 100 mg every 8 hours by your colleague. They are concerned about the "addiction" after seeing recent UDS results. What is your interpretation of the test?

OPIATES	Lab Results	ng/ml	Cutoff (ng/ml)
Opiates (IA)	Positive	>800	50
Codeine (MS)	Negative	0	50
Morphine (MS)	Positive	6878	50
Hydrocodone (MS)	Negative	0	50
Hydromorphone (MS)	Positive	112	50
Oxycodone (MS)	Negative	0	50

OPIOID METABOLISM



Smith HS. Opioid metabolism. Mayo Clin Proc. 2009 July; 84(7): 613-624.

Case #5

52 yo WM on methadone 80 mg daily presents to discuss results from most recent urine drug screen. What's your interpretation?

	Lab Results	Cutoff (ng/ml)
Opiates (IA)	Negative	50
Benzodiazepines (IA)	Negative	200
Amphetamines (IA)	Negative	1000
Methadone (IA)	Positive	50
Methadone Metabolite/EDDP (IA)	Negative	50
Cocaine (IA)	Negative	50
THC (IA)	Negative	50
Buprenorphine (IA)	Negative	10
Fentanyl (IA)	Negative	10
Barbituates (IA)	Negative	50
Oxycodone (IA)	Negative	50

Case #5

	Lab Results	ng/ml	Cutoff
Methadone (IA)	Positive		300 ng/ml
EDDP (IA)	Negative		300 ng/ml
Methadone (MS)	Positive	3102	1 ng/ml
EDDP (MS)	Negative	0	1 ng/ml

Interpretation?

Urinary Diversion

Case #5

Repeat lab results on closely observed urine collection.

	Lab Results	Cutoff (ng/ml)
Opiates (IA)	Negative	50
Benzodiazepines (IA)	Negative	200
Amphetamines (IA)	Negative	1000
Methadone (IA)	Positive	50
Methadone Metabolite/EDDP (IA)	Positive	50
Cocaine (IA)	Negative	50
THC (IA)	Negative	50
Buprenorphine (IA)	Negative	10
Fentanyl (IA)	Positive	10
Barbituates (IA)	Negative	50
Oxycodone (IA)	Negative	50

Case #6

47 yo female on 210 mg of methadone has a UDS following reinstatement in the clinic after 5 days of inpatient withdrawal management for benzodiazepine misuse. She denies any BZD misuse since prior to admission. What do you do next?

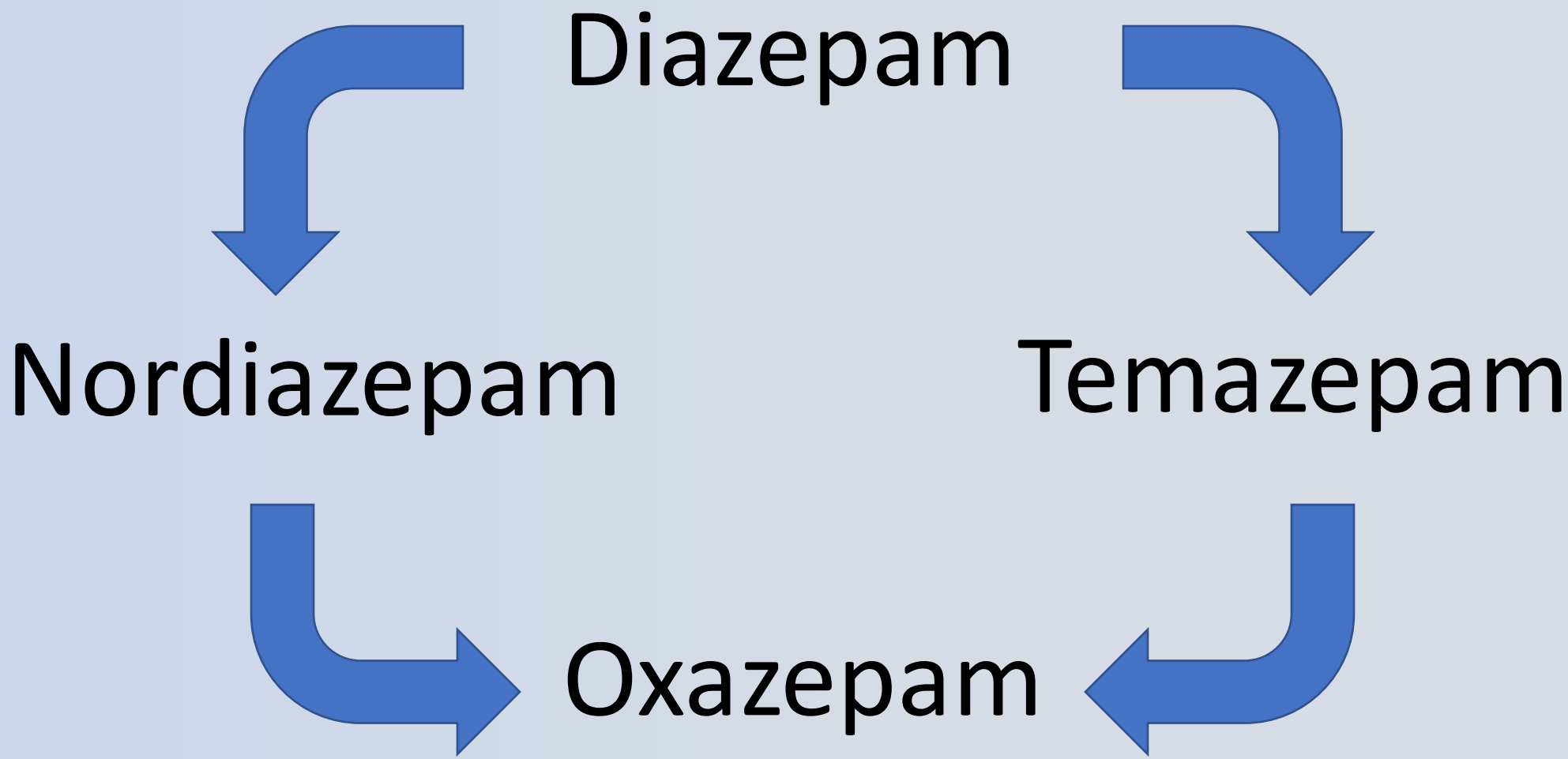
Testing Results

Test	Result	Outcome	Cutoff
Screening Tests by IA			
URINE: Meth/Amphetamines		negative	1000 ng/ml
URINE: Barbiturates		negative	300 ng/ml
URINE: Benzodiazepines		**POSITIVE	300 ng/ml
URINE: Cocaine		negative	300 ng/ml
URINE: Methadone		**POSITIVE	300 ng/ml
URINE: Methadone Metabolite		**POSITIVE	300 ng/ml
URINE: Opiates		negative	300 ng/ml
URINE: THC		negative	50 ng/ml
URINE: Oxycodone		negative	300 ng/ml
URINE: Buprenorphine/Suboxone		negative	5 ng/ml
URINE: Fentanyl		negative	2.0 ng/ml
Specimen Validity Tests			
Specimen Validity Panel			
URINE: Creatinine	70.6 mg/dl		20 mg/dl
Basic Adulteration Check		normal	

Case #6

- Positive for:
  - Oxazepam
  - Nordiazepam
  - Temazepam
- What did patient take?

Confirmation Tests			
Benzodiazepines by LC/MS/MS			
URINE: Oxazepam	740 ng/ml	**POSITIVE	100 ng/ml
URINE: Nordiazepam	122 ng/ml	**POSITIVE	100 ng/ml
URINE: Temazepam	328 ng/ml	**POSITIVE	100 ng/ml
URINE: Lorazepam	Not Detected	negative	100 ng/ml
URINE: Alprazolam-Metabolite	Not Detected	negative	100 ng/ml
URINE: Flurazepam-Metabolite	Not Detected	negative	100 ng/ml
URINE: Clonazepam-Metabolite	Not Detected	negative	100 ng/ml
URINE: Midazolam	Not Detected	negative	100 ng/ml
URINE: Triazolam-Metabolite	Not Detected	negative	100 ng/ml
Specimen Validity Tests			
Specimen Validity Panel			
URINE: Creatinine	178.6 mg/dl		20 mg/dl
Basic Adulteration Check		normal	


Diazepam
Nordiazepam
Temazepam
Oxazepam

Case #6

Your patient presents to the office 3 weeks later in tears. The patient reports the recovery housing facility she is staying in had her do a drug test and it was positive for benzodiazepines. Staff at the facility confronted patient and stated she may be dismissed from the facility for ongoing substance misuse. Patient states she has had no further benzodiazepine use since prior to admission for withdrawal management. She asks for you to repeat the UDS in the office. It is positive for benzodiazepines on POC testing. Next step?

Test #1

Confirmation Tests			
Benzodiazepines by LC/MS/MS			
URINE: Oxazepam	740 ng/ml	**POSITIVE	100 ng/ml
URINE: Nordiazepam	122 ng/ml	**POSITIVE	100 ng/ml
URINE: Temazepam	328 ng/ml	**POSITIVE	100 ng/ml
URINE: Lorazepam	Not Detected	negative	100 ng/ml
URINE: Alprazolam-Metabolite	Not Detected	negative	100 ng/ml
URINE: Flurazepam-Metabolite	Not Detected	negative	100 ng/ml
URINE: Clonazepam-Metabolite	Not Detected	negative	100 ng/ml
URINE: Midazolam	Not Detected	negative	100 ng/ml
URINE: Triazolam-Metabolite	Not Detected	negative	100 ng/ml
Specimen Validity Tests			
Specimen Validity Panel			
URINE: Creatinine	178.6 mg/dl		20 mg/dl
Basic Adulteration Check		normal	

Test #2

Confirmation Tests			
Benzodiazepines by LC/MS/MS			
URINE: Oxazepam	>500 ng/ml	**POSITIVE	100 ng/ml
URINE: Nordiazepam	47 ng/ml	Detected	100 ng/ml
URINE: Temazepam	105 ng/ml	**POSITIVE	100 ng/ml
URINE: Lorazepam	Not Detected	negative	100 ng/ml
URINE: Alprazolam-Metabolite	Not Detected	negative	100 ng/ml
URINE: Flurazepam-Metabolite	Not Detected	negative	100 ng/ml
URINE: Clonazepam-Metabolite	Not Detected	negative	100 ng/ml
URINE: Midazolam	Not Detected	negative	100 ng/ml
URINE: Triazolam-Metabolite	Not Detected	negative	100 ng/ml
Specimen Validity Tests			
Specimen Validity Panel			
URINE: Creatinine	132.4 mg/dl		20 mg/dl
Basic Adulteration Check		normal	

BENZODIAZEPINES

- Cut off typically 200 or 300 ng/mL
  - May not detect therapeutic doses
- Many detect nordiazepam and oxazepam
  - Chlordiazepoxide, clorazepate, diazepam
- Many benzodiazepines cross-react poorly with standard assays
  - Clonazepam, lorazepam and triazolam less likely to be detected

Drug	Detection Time
Amphetamines/Methamphetamine	1-3 days
Cocaine - Prolonged heavy use	2-4 days 10-22 days
Marijuana - Infrequent use - Prolonged/heavy use	 1-3 days Up to 30 days
Benzodiazepines	1-3 days; up to 6 weeks with heavy use of long-acting BZO
Opiates	1-2 days
Methadone Buprenorphine	2-11 days 3-4 days
Fentanyl - Prolonged heavy-use	1-2 days Limited data suggests average 14 days, may persist longer

Adapted from SAMHSA. TIP 63

Urine Specimen Validity Testing

Characteristic	Description
Creatinine (Cr)	By product of muscle metabolism and produced at a fairly constant rate by the body. SAMHSA has criteria for normal concentrations, < 20 mg/dL = dilute sample. Very high levels may occur with some adulterants.
pH	Ranges between 4.5 and 8.0 in urine. Abnormal pH may be result of adulterant but can also be due to UTI as well as diets high in protein/low in carbohydrates.
Specific Gravity	Normal range in urine is 1.003 – 1.030. Many sources suggest to check only if Cr < 20 mg/dL.
Immunoglobulin (IgG)	Most common antibody in bloodstream. Concentrations < 0.5 µg/ml suggest sample substituted with synthetic or animal urine. Not as commonly used.
Adulterants	Some labs test for presence of specific adulterants such as glutaraldehyde, nitrites and pyridium chlorochromate. Not all adulterants included in standard test, including Visine eye drops.

Adapted from American Society of Addiction Medicine. Appropriate use of drug testing in clinical addiction medicine. 2017.

Case #7

44 yo male on BUP/NAL 8/2 mg BID presents for office f/u. His most recent screen results are shown. Patient reports no substance misuse. He does state he has had viral illness and has been using OTC medications. Could this be the cause of his results?

Stimulants					
Amphetamine	Confirm		ND	100	CONSISTENT
Methamphetamine	Confirm	195	POS	100	INCONSISTENT
Differentiation of Methamphetamine D/L Isomers:					
%D		*0 %*			
%L		*100 %*			
Ritalinic Acid	Confirm		ND	50	CONSISTENT
Analgesic/Anesthetic					
Fentanyl	Confirm		ND	1.0	CONSISTENT
Norfentanyl	Confirm		ND	10	CONSISTENT
Tapentadol	Confirm		ND	50	CONSISTENT
N-Desmethyltapentadol	Confirm		ND	50	CONSISTENT
Tramadol	Confirm		ND	50	CONSISTENT
Desmethyltramadol	Confirm		ND	50	CONSISTENT
Benzodiazepine					
Temazepam	Confirm		ND	50	CONSISTENT
Oxazepam	Confirm		ND	50	CONSISTENT
Lorazepam	Confirm		ND	50	CONSISTENT
Alprazolam	Confirm		ND	50	CONSISTENT
a-Hydroxyalprazolam	Confirm		ND	50	CONSISTENT
7-Aminoclonazepam	Confirm		ND	50	CONSISTENT
Nordiazepam	Confirm		ND	50	CONSISTENT
Opiate/Opioid					
Buprenorphine	Confirm	119	POS	2.5	INCONSISTENT
Norbuprenorphine	Confirm	726	POS	10	INCONSISTENT
Methadone	Confirm		ND	50	CONSISTENT
EDDP	Confirm		ND	50	CONSISTENT
Norcodeine	Confirm		ND	50	CONSISTENT
Codeine	Confirm		ND	50	CONSISTENT
Morphine	Confirm		ND	50	CONSISTENT
Hydrocodone	Confirm		ND	50	CONSISTENT

Methamphetamines

- 2 stereoisomers:
  - D-methamphetamine = strong CNS stimulant, potent dopaminergic effects
  - L-methamphetamine = mildly dopaminergic, vasoconstrictive effects, used in Vicks VapoInhaler®
- Smith et al, 2014:
  - N = 17
  - Used VapoInhaler per package instructions (28 inhalations over 32 hours)
  - No detectable D-methamphetamine
  - L-methamphetamine median peak concentration = 62.8 ug/L (11.0-1,440)

OTHER DRUG CLASSES

- Amphetamine screening:
  - Amphetamine, methamphetamine, MDMA
  - Greater incidence of false positives
  - Need specific testing for methylphenidate (Ritalin©)
- Cocaine
  - Detects metabolite benzoylecgonine (BZE) → highly specific/sensitive
- Marijuana
  - Detects Δ9-THC, federally mandate cutoff = 50 ng/mL
  - CBD may trigger positive test

Case #8

38 yo male patient with history of severe alcohol use disorder presents to clinic for treatment. He reports drinking 12-24 beers/day for the past 10 years and was recently hospitalized 8 days for alcohol-induced pancreatitis. Patient reports no alcohol use since discharge 3 days ago. After evaluation and consultation with patient, he is started on oral naltrexone. Plan is made for serial alcohol screening to support his abstinence from alcohol. What testing methods are available?

ALCOHOL TESTING

- Ethanol → blood, urine, breath or saliva tests
- Serum ethanol conversion to BAC
  - Move decimal point 3 places to the left
  - Ex: 50 mg/dL = 0.05 (g/dL) BAC = 50 mg%
- Urine
  - Ethyl alcohol: 10-12 hours
    - *does not correlate to blood levels well
    - Metabolites (EtS, EtG): 1-2 days, up to 5 days w/ heavy binge drinking

Case #8

Patient does well on naltrexone treatment for the first 3 months with negative urine screens for ethyl alcohol. At today's visit patient appears disheveled and poorly groomed which is different from how he previously presented. He reports continued abstinence from alcohol. POC testing in the office is negative. You are concerned about a return to use and patient consents to confirmatory testing.

Case #8

	Lab Results	%	Cutoff
Ethanol (IA)	Negative	0	0.2%
Ethanol (LC/MS)	Negative	0	0.2%

Ethyl alcohol present in urine for only 10-12 hours

	Lab Results	ng/ml	Cutoff
Ethanol (IA)	Negative	0	0.2%
Ethyl Glucuronide	Positive	2408	500 ng/ml
Ethyl Sulfate	Positive	1300	100 ng/ml

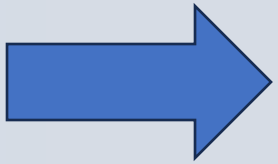
Metabolite testing allows assessment of alcohol intake for 1-2 days, correct test to order in this situation

Case #9

68 yo female patient with history of OUD, CAD and DM II presents for f/u at her OTP to discuss recent ethanol positive on urine drug screen. Patient is on a stable methadone dose of 135mg PO daily and reports no alcohol use. You request confirmation with alcohol metabolite testing.

Case #9

	Lab Results	ng/ml	Cutoff
Ethanol (IA)	Negative	0	0.2%
Ethyl Glucuronide	Positive	1905	500 ng/ml
Ethyl Sulfate	Negative	0	100 ng/ml



Positive EtG in the absence of EtS – may not indicate alcohol consumption

Alcohol Metabolite Testing

Combination urine Ethyl Sulfate (EtS) and Ethyl glucuronide (EtG)

- Minor metabolites of Ethanol
- Provides the most reliable indication of recent alcohol intake.
- Detection Window: 1-2 days, up to 5 days w/ heavy binge drinking
- Testing for both biomarkers strengthens the reliability of the results.
- High sensitivity and specificity for alcohol intake
    - EtG sensitivity 70-89%, specificity 93-95%
    - EtS sensitivity 73-82 %, specificity 86-89%

Alcohol Metabolite Testing

- Interpreting EtS/EtG results:
  - Positive EtG suggests EtOH consumption, alone not definitive proof
    - Can be produced by microbial fermentation/metabolism = false positive
    - Can be absent if bacterial contamination due to bacterial decomposition = false negative
  - EtS not shown to be produced/degraded in urine

Result	Interpretation
EtG negative, EtS negative	False positive; negative for alcohol consumption
EtG positive, EtS negative	May not indicate alcohol consumption, correlate clinically
EtG negative, EtS positive	Consistent with alcohol consumption
EtG positive, EtS positive	Consistent with alcohol consumption

Case #9

You review medication list and note that patient is on Empagliflozin a STGLT2 inhibitor that increases urinary glucose and thus the probability of ex vivo production of urinary glucose to ethanol and EtG. After reviewing these findings you conclude that positive ETOH is not necessarily related to consumption of alcoholic beverages.

CONCLUSIONS

- Drug testing is a tool with potential to improve outcomes if used consistently and correctly
- There are advantages and limitations with each testing method
- Presumptive testing needs to be confirmed
  - Patient can confirm use
  - Definitive testing

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