INFORMATION SHEET

URINE CREATININE AND THC/CREATININE RATIOS

WHY MEASURE CREATININE?

Abbott routinely determines the creatinine concentration in all specimens submitted for testing. Creatinine is a waste product from muscle tissue that is excreted in urine that is routinely used to check kidney function. Additionally, it is an important parameter for evaluating urine samples submitted for drug testing, as follows.[1]

ASSESSING URINE DILUTION OR SUBSTITUTION ATTEMPTS

Because of the potential consequences of a positive drug test, an individual might be motivated to "cheat" the test using various techniques. One of the most common practices used to avoid a positive drug test is the intentional consumption of excess fluid in a relatively short period of time in an effort to flush the system. This is commonly referred to as water-loading or dilution and can result in lowering drug concentrations below the positive cutoff concentration level, consequently causing a false negative result. Dilute urine is usually seen 2 hours after drinking large amounts of water (e.g. 2-4 quarts) and can last up to several hours.[2] Measuring creatinine helps assess an individual's level of hydration. In drug testing, it can detect if the urine is too dilute, indicating possible attempt at cheating.[2]

DETERMINING RENEWED THC USE

Another important aspect of creatinine interpretation is its use to monitor abstinence from marijuana. The concentration of the THC metabolite, carboxy-THC, can fluctuate from day-to-day depending upon a person's fluid intake. The calculation of the carboxy-THC to creatinine ratio is of considerable value when trying to determine if an individual has abstained from marijuana use.

CREATININE INTERPRETATION

Normal Creatinine Levels

Normal creatinine levels are typically between 20 and 400 mg/dL. Creatinine levels in urine depend on biometric factors such as muscle mass, sex, age and physical health. In general, the more muscle mass one has, the higher the creatinine level may be—which is why men tend to have higher normal creatinine levels than women, children and the elderly. Certain physiological conditions like diabetes can cause consistently dilute urine.[1,3]

How We Report Dilution

Abbott follows federal regulation guidelines to report dilute urine samples. Federal regulations include two critical points for creatinine levels to help determine if urine is too dilute or substituted:

- Less than 20 mg/dL (dilute)
- Less than or equal to 2 mg/dL (abnormally dilute).[4]

Urine specimens with creatinine levels of less than 20 mg/dL may indicate water-loading or dilution due to an adulterant having been added to a specimen.[2]

Recommendations to Counteract Dilution Attempts

Low urine creatinine values may indicate that an individual attempted to beat the drug test by drinking excessive fluid in an effort to flush the drugs from his or her system. If low creatinine is found, you can implement the following measures to combat subsequent dilution attempts by the donor:

- Increase the frequency of urine collections
- Ask the donor to provide samples in the morning or within two hours of notification
- Limit water intake to two eight-ounce glasses within two hours before the collection

WHAT IS A THC/CREATININE RATIO AND WHY IS IT RELEVANT?

THC Detection and Usage Patterns

THC is the main psychoactive ingredient in marijuana. THC metabolites show up in urine 2-4 hours after smoking and can last up to 30 days, depending on usage patterns. In general, THC is detectable in urine at the 50 ng/mL screening cutoff for the following lengths of time:[5]

- Single use: detectable for 1-3 days.
- Moderate use: detectable for 5-7 days.
- Daily use: detectable for up to 10-15 days.
- Long-term/chronic use: detectable >30 days.

Note: Passive inhalation of marijuana is unlikely to cause a positive urine test at the 50 ng/mL cutoff.[6]

Importance of Creatinine Measurement in THC Results

THC metabolite levels can fluctuate from day to day based on fluid intake: more fluids lower both THC metabolite and creatinine levels, while dehydration increases both levels.[7] Creatinine levels help determine if someone has abstained from marijuana between tests or if renewed use has occurred.

Ratio Calculation

Calculating the carboxy-THC to creatinine ratio helps account for hydration changes. This ratio can be calculated by dividing the THC value by the Creatinine value then multiplying by 100. This ratio value—the THC/Creatinine Ratio—is a "normalized" data point that can be compared across consecutive urine samples to see if marijuana use has resumed.[7]

Interpretation of Ratios[8]

Below are some general guidelines for interpreting marijuana results (in urine), taking the THC/Creatinine Ratio into consideration to assess renewed or continued using at least three consecutive results to establish a pattern:

- **Decreasing Ratio:** Indicates no new THC use. The THC/Creatinine ratio should decrease over time as the body metabolizes and excretes THC.
- **Stable Ratio:** Suggests consistent THC levels, which could indicate ongoing use or a steady state of excretion.
- **Increasing Ratio:** May indicate recent THC use, as the THC levels are rising relative to creatinine. In general, if the THC/Creatinine ratio increases by more than 50% between two urine samples, it likely indicates renewed marijuana use.[8]

Example Test Results

Scenario 1: No New Use (Decrease in THC-COOH/Creatinine ratio)

TEST DATE	THC-COOH (NG/ML)	CREATININE (MG/DL)	THC/CREATININE RATIO
11/25/2024	60	100	60
11/28/2024	90	160	56
12/1/2024	50	100	50

Interpretation: In this case, the decreasing THC-COOH/Creatinine ratio from 60 to 50 suggests no new THC use between the test dates.

Scenario 2: No New Use (Decrease in THC-COOH/Creatinine ratio)

TEST DATE	THC-COOH (NG/ML)	CREATININE (MG/DL)	THC/CREATININE RATIO
11/25/2024	200	350	57
11/28/2024	150	300	50
12/1/2024	100	300	33

Interpretation: Change in THC-COOH/Creatinine ratio does not indicate new use.

Scenario 3: New Use

TEST DATE	THC-COOH (NG/ML)	CREATININE (MG/DL)	THC/CREATININE RATIO
11/25/2024	100	100	100
11/28/2024	500	250	200
12/1/2024	1500	250	600

Interpretation: In this case, the increasing THC-COOH/Creatinine ratio shows a large enough increase to indicate new use.

Clinical consideration and professional judgment should be applied for more reliable interpretation. Abbott strongly recommends consultation with a toxicologist and a liquid chromatography/tandem mass spectrometry (LC-MS/MS) confirmation prior to official or legal actions.

REFERENCES:
1. Barr DB, Wilder LC, Caudill SP, Gonzalez AJ, Needham LL, Pirkle JL. Urinary creatinine concentrations in the U.S. population: implications for urinary biologic monitoring measurements. Environ Health Perspect. 2005 Feb;113(2):192-200. doi: 10.1289/ehp.7337. PMID: 15687057; PMCID: PMC1277864
2. Amitava Dasgupta, The Effects of Adulterants and Selected Ingested Compounds on Drugs-of-Abuse Testing in Urine, American Journal of Clinical Pathology, Volume 128, Issue 3, September 2007, Pages 491–503, https://doi.org/10.1309/FQY06F8XKTQPM149
3. Hosten AO. BUN and Creatinine. In: Walker HK, Hall WD, Hurst JW, editors. Clinical Methods: The History, Physical, and Laboratory Examinations. 3rd edition. Boston: Butterworths; 1990. Chapter 193. Available from: https://www.ncbi.nlm.nih.gov/books/NBK305/
4. US Department of Transportation. (n.d.). DOT Rule 49 CFR Part 40 Section 40.88. Retrieved from https://www.transportation.gov/odapc/part40/40-88
5. 15a1724e-fd69-461b-ad2b-4c160fdc814e_source__v.pdf
6. Dasgupta, A. (2010). Defending positive opiate and marijuana test results. In Beating drug tests and defending positive results. Humana Press. https://doi.org/10.1007/978-1-60761-527-9_7 https://play.google.com/books/reader?id=sADqtOR56IkC&pg=GBS.PP1&hl=en
7. Smith, M. L., Barnes, A. J., & Huestis, M. A. (2009). Identifying new cannabis use with urine creatinine-normalized THCCOOH concentrations and time intervals between specimen collections. Journal of Analytical Toxicology, 33(4), 185-189. https://doi.org/10.1093/jat/33.4.185
8. Cary, P. L. (2002). The use of creatinine-normalized cannabinoid results to determine continued abstinence or to differentiate between new marijuana use and continuing drug excretion from previous exposure. National Drug Court Institute Review, 4(1), 83-104

TO LEARN MORE, VISIT TOXICOLOGY.ABBOTT

Abbott