

DRIED URINE TEST SPECIFICATIONS

Cadmium

Clinical Information

Cadmium is a highly toxic heavy metal that is classified by the IARC as a group I carcinogen. It contributes to unexplained infertility in both men and women through a variety of mechanisms, including endocrine signal disruption and testicular accumulation affecting spermatogenesis. It acts as an estrogen mimic, stimulating cell proliferation in estrogen-responsive tissues and increasing risk of uterine fibroids and other reproductive tract diseases. Occupational exposure arises mainly from smelting of zinc, lead, and copper ores, and from battery manufacturing; it enters the atmosphere as a result of such industries as well as from fossil fuel combustion and waste incineration. It is deposited in the soil, taken up by plants and thus enters the food supply, which is the main source of cadmium exposure in non-smokers. Tobacco leaves accumulate high levels of cadmium; smokers have twice the body burden of cadmium compared to non-smokers. Once ingested, cadmium binds to albumin and metallothionein in the circulation and is filtered by the kidneys, accumulating in the kidney cortex with a half-life of >10 years. Urinary cadmium correlates with kidney tissue levels and is accepted as an accurate measure of total body burden. Two dried urine samples are collected for cadmium testing; first morning and last night. The cadmium content is averaged for the two samples, which we have found to correlate excellently with results from a simultaneous 24-hour urine collection. Cadmium levels are corrected using urinary creatinine to allow for variations in hydration status. The reference range is <0.72 µg cadmium/g creatinine.

References:

ATSDR Public Health Statement for Cadmium; September 2012.
IARC Monograph 100C (2012): Cadmium and cadmium compounds.
Thompson J, Bannigan J. Cadmium: toxic effects on the reproductive system and the embryo. *Reprod Toxicol.* 2008;25:304-15.
Kortenkamp A. Are cadmium and other heavy metal compounds acting as endocrine disrupters? *Met Ions Life Sci.* 2011;8:305-17.
Zava TT, Kapur S, Zava DT. Iodine and creatinine testing in urine dried on filter paper. *Anal Chim Acta* 2013;764:64-9.

Assay Method: ICP-MS

Intra-assay Precision

Intra-assay precision was determined by choosing three dried urine samples spanning the reference range for cadmium, and analyzing them 20 times within the same run. Results are shown below:

Mean Cadmium Concentration (µg/L)	Standard Deviation	Coefficient of Variation (C.V. %)
0.12	0.02	19.6
0.34	0.05	13.3
0.74	0.06	8.1

Inter-assay Precision

Inter-assay precision was determined by choosing three samples spanning the reference range for cadmium, and analyzing them over a 1-month period. Results are shown below:

Mean Cadmium Concentration (µg/L)	Standard Deviation	Coefficient of Variation (C.V. %)
0.34	0.04	12.3
0.74	0.08	10.3
5.62	0.29	5.2

Accuracy

To test the accuracy of the dried urine assay for cadmium, external urine controls containing known concentrations of cadmium were analyzed. An inter-laboratory comparison was also performed with matching samples. Results are shown below:

External Control	Expected Cadmium (µg/L)	ZRT Cadmium (µg/L)	Inter-Laboratory Comparison	Other Lab Result (µg/L)	ZRT Result (µg/L)
SeroNorm Trace Elements Level 1	0.19	0.25	Sample 1	0.24	0.19
SeroNorm Trace Elements Level 2	4.9	4.63	Sample 2	1.00	0.85
ClinChek Trace Elements Level 1	2.46	2.43			
ClinChek Trace Elements Level 2	14.4	13.86			
BioRad 400 Lyphocheck Metals Level 1	9.81	9.6			
BioRad 405 Lyphocheck Metals Level 2	18.4	18.82			

Analyte Stability

The dried urine cadmium samples are stable for more than one month at room temperature and for more than six months when stored at -80°C. Three freeze-thaw cycles did not cause a significant change in concentration.

Specimen Collection

Kits for dried urine collection contain two filter paper collection strips, easy-to-follow instructions, and a mailer to return the sample for analysis.