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Advancing the Science of Wellness
Rocky Mountain Analytical

Date of Collection: 17-Oct-2011
Sample Received: 21-Oct-2011
Reported Date: 25-Oct-2011
Sample Type: Urine

Urine Element Analysis Report — Accession Number: 293142

Provider:

Patient:

Gender : F
Date of Birth :
Age: 65

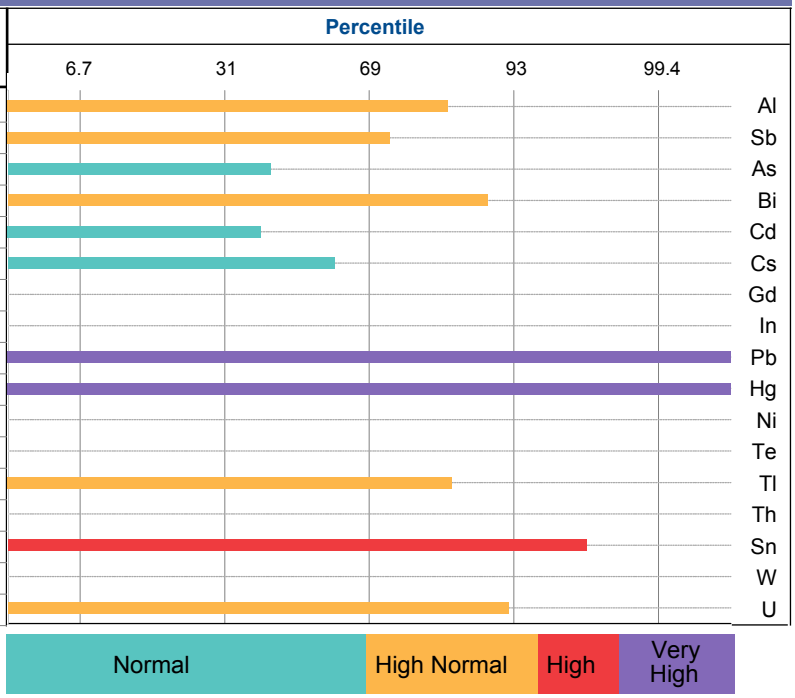
Fax:

Collection Period: TIMED 6.00 hrs
Urine Volume: N/A

Provocation: *POST-PROVOCATION
Provoking Agent: DMSA

URINE TOXIC / POTENTIALLY TOXIC ELEMENTS — Accession # 293142

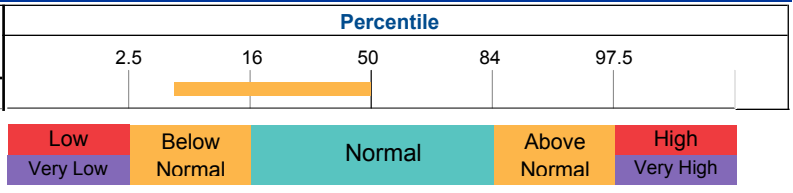
Toxic Elements	Results ug/g Cr	Reference Range ug/g Cr
Aluminum	23	<39
Antimony	0.13	<0.35
Arsenic	15	<81
Bismuth	0.096	<0.20
Cadmium	0.34	<1.1
Cesium	4.5	<10
Gadolinium	< dl	<0.040
Indium	< dl	<0.029
Lead	34	<3.9
Mercury	7.6	<1.3
Nickel	< dl	<14
Tellurium	< dl	<0.41
Thallium	0.31	<0.40
Thorium	< dl	<0.062
Tin	3.3	<2.6
Tungsten	< dl	<0.29
Uranium	0.021	<0.027



< dl = result is less than detection limit

URINE CREATININE

Analyte	Result g/L	Reference Range g/L
Creatinine	0.33	0.50 - 1.8



*Note: Urine sample was marked post-provocation. Reference ranges are based on measurement of unprovoked specimens and are provided for information purposes only. Graphing of the post-provocation sample using pre-provocation ranges may not accurately reflect the clinical picture. Providers must exercise caution interpreting the meaning of these graphs.

Collection Period: TIMED
Urine Volume: 0 ml

Provocation: *POST-PROVOCATION
Provoking Agent: DMSA

URINE ESSENTIAL ELEMENTS — Accession # 293142

Unavailable

Interpretation — Accession Number: 293142

DISCLAIMER FOR TOXIC/POTENTIALLY TOXIC ELEMENTS
This specimen was obtained following administration of a chelating agent, which binds to chemical elements such as lead and mercury, and makes them available for elimination in urine. This is a widely established practice, which has helped many people identify hidden factors affecting their health; however, there is no perfect, "gold standard" chelating agent, so there is always the possibility that the elements appearing in the urine under-represent what is actually present in the various body tissues, depending on the agent used, and the route of administration.

Our reference ranges are derived from normal, healthy, age and gender matched persons who did not receive a chelating agent prior to specimen collection. This begs the question: When healthy, asymptomatic people are given the same chelating agent as this patient, how much of the various toxic elements do they excrete? In other words, are there threshold levels of toxic element excretion that most people can tolerate without incident? The best we can say is that we always have to treat each person as an individual. Even if we could find a "safe threshold" for a given element, there are always going to be people who might still be affected by a body burden below that threshold, for that element.

The fact that a chelating agent pulls a certain amount of a toxic element or elements out of storage and into urine does not always correlate with symptoms/presence of chronic illness. Practitioners need to use their experience and skill, along with the clinical picture, when interpreting these test results.

ALUMINUM HIGHER THAN AVERAGE (YELLOW BAR)
Accepting the limitations of the reference ranges, if one hundred healthy, normal people are tested without provocation, about twenty-seven of them would have an aluminum result in the same range into which this patient's result falls (yellow bar). In an unprovoked sample, this result would be considered higher than average. Urine measurement is considered quite accurate for aluminum, since about 95% of aluminum excretion is via urine.

There are many opportunities for the average individual to be exposed to aluminum. Aluminum compounds are used in water treatment plants, to clarify the water and to introduce fluoride. Baking powder may contain aluminum, and foods cooked in uncoated aluminum cookware may absorb aluminum, depending on the acidity of the food being cooked. Processed cheese is high in aluminum. Most adults are exposed to aluminum due to use of aluminum-containing antiperspirants and use of antacids. Children absorb aluminum more readily than adults and are more sensitive to toxicity.

Aluminum concentrates in the body in areas where phosphate concentration is highest; it has a tendency, therefore, to accumulate inside cells. Aluminum can be neurotoxic and has been implicated in dementia. Various studies of welders exposed to aluminum-containing vapours have indicated that urinary aluminum levels above 100 ug/L (not normalized to creatinine) are associated with neurological effects such as decreased reaction time, diminished fine motor skills, as well as impairments of memory and concentration. Elevated aluminum intake impairs nitrogen metabolism and increases serum ammonia, and also interferes with bone remodelling via depletion of phosphate.

ANTIMONY HIGHER THAN AVERAGE WITH PROVOCATION (YELLOW BAR)
Accepting the limitations of the reference ranges, if one hundred healthy, normal people are tested without provocation, about twenty-seven of them would have a result encompassing the range into which this patient's result falls (yellow bar). In an unprovoked sample, this result would be considered higher than average.

Note that DMPS and DMSA are more likely to increase urinary antimony excretion, compared to EDTA. (EDTA has poor affinity for metal ions with valences of +3 or higher.) The literature is not conclusive as to which valence is excreted in urine. Some sources say urine favours the +3 form; others say that both +3 and +5 are both excreted in urine. This is relevant because the +3 valence is less toxic than the +5 form. A urine antimony result

should not be casually dismissed based on the assumption that it represents only the less toxic +3 valence.

Most people have some exposure to antimony through the flame-retardant treatments applied to upholstery, carpets, drapes and some clothing (in particular children's pyjamas), as well as contaminated food and water. Interestingly, a 2010 study did not see elevated antimony in firefighters wearing flame-retardant clothing. (de Perio MA et al. A health hazard evaluation of antimony exposure in fire fighters. J Occup Environ Med 2010;52(1):81-84.) Trace amounts of trimethylstibine gas can be produced by the action of the fungus S. brevicaulis and other micro-organisms on inorganic sources of antimony, so there is theoretical concern about toxicity from moulds growing on antimony-containing substrates. Antimony can be found in PETE plastic. Antimony is also found in gunpowder; individuals who frequent firing ranges and load their own ammunition may be exposed to antimony. Cigarette smoke contains some absorbable antimony.

Acute and chronic inhalation of antimony causes upper and lower respiratory tract irritation. Chronic antimony intoxication can lead to nonspecific complaints such as fatigue, achiness, GI complaints and general malaise, as well as muscle weakness. These symptoms may be due to interference with cellular metabolism through binding to sulphydryl sites on various enzymes. Antimony is toxic to the liver and heart, and can cause cardiac arrhythmia and cardiomyopathy.

BISMUTH HIGHER THAN AVERAGE WITH PROVOCATION (YELLOW BAR)
Accepting the limitations of the reference ranges, if one hundred healthy, normal people are tested without provocation, about twenty-seven of them would have a bismuth result in the same range into which this patient's result falls (yellow bar). In an unprovoked sample, this result would be considered higher than average.The primary route of excretion for bismuth is urine, so elevated urine bismuth is normally considered to reflect of bismuth exposure.

Bismuth is not a significant contaminant of commercially-available food and daily intake is estimated to be on the order of 20 mcg/day. Bismuth shot is popular as a nontoxic replacement for lead shot, but can be ingested by waterfowl. One might conceivably have increased exposure to bismuth with steady consumption of wild waterfowl,as elevated levels of bismuth are found in the tissues of birds ingesting such shot. Gun enthusiasts who load their own shotgun shells may be exposed to bismuth through contact with bismuth shot. Significant amounts of bismuth may be ingested chronically in the form of over the counter preparations intended to alleviate GI symptoms such as dyspepsia, nausea, gastritis/ulcer pain, and diarrhea, and urine bismuth may be elevated in these situations. (DiPalma JR. Bismuth toxicity. Am Fam Phys 1988;36:244.) Bismuth is found in cosmetics (e.g.foundation), as a "pearlizing agent" because it produces a shimmery, pearlescent appearance and has a fine white powder texture that adheres well to skin. In industry, bismuth metal is used to manufacture alloys, catalysts, ceramics, magnets, paints, pharmaceuticals, and semiconductors. No toxicity from industrial exposure to bismuth has been reported. Bismuth is generally considered to be non-toxic in acute exposure. Large (multigram) oral doses of absorbable bismuth are needed to produce immediate symptoms of toxicity.

Bismuth encephalopathy is a rare and often reversible complication of chronic bismuth ingestion. It has been mistaken for Alzheimer's Dementia (Summers WK. Bismuth Toxicity Masquerading as Alzheimer's Dementia. J Alzheimers Dis 1998;1(1):57-59.) and can manifest in the setting of chronic ingestion of over the counter remedies, as mentioned above. Symptoms of bismuth encephalopathy include fatigue, lethargy, changes in mental status, memory impairment, tremor, ataxia, and myoclonus. A characteristic linear blue-black gingival pigmentation ("Bismuth line") may develop with chronic bismuth exposure. Chronic bismuth toxicity may also present with a neurologic picture similar to Parkinsonism. There are older reports of such presentations in individuals treated with bismuth preparations for syphilis.

DMPS/DMSA DO NOT CHELATE CADMIUM WELL
According to Crinnion (Alt Med Rev 2009;14:103-108), cadmium is not mobilized well by DMPS or DMSA. EDTA is the best choice to mobilize cadmium. Cadmium results obtained post-DMPS or post-DMSA challenge may under-reflect tissue stores.

LEAD VERY HIGH WITH PROVOCATION (PURPLE BAR)
Accepting the limitations of the reference ranges, if one hundred healthy, normal people are tested without provocation, approximately one of them would have a lead result in the same range into which this patient's result falls (purple bar). In an unprovoked sample, this result would be considered very high. A provoked result in this range does not automatically mean that the body burden of lead is extrememly high, but it is suggestive. Note that urine is a significant excretory pathway for lead, but it is by no means a uniformly reliable indicator of blood lead.

Note also, that a purple bar for lead might be seen for lead if the creatinine is markedly low. The reported value is the raw result divided by the creatinine; a markedly low creatinine can artificially inflate the normalized result. In the absence of an artifact due to low creatinine, a result in the red or purple range for lead should at a minimum,

prompt a very thorough review of the clinical picture, looking for signs and symptoms of chronic lead exposure.

Food contains lead, depending on the level of contamination in the air, water and soil where the food is grown. People of all ages may gain exposure to lead through drinking water from an older plumbing system which still uses lead pipes. Adults often come in contact with lead unknowingly through stripping old lead-based paint. Gun enthusiasts may be exposed to lead through handling/loading bullets and through indoor shooting. Fumes from some types of electrical solder may contain lead. Note that use of lead-containing hair dye products will elevate hair lead levels significantly; systemic absorption of lead through the scalp, from use of these products is low, but lead can still be introduced systemically in these instances, via hand-to-mouth (http://www.uwsp.edu/geo/courses/geog100/MielkeHairLead1.htm). Herbal remedies may occasionally contain lead, especially if sourced outside North America. Some ceramic glazes (pottery, dishes) are known to contain lead and children may be exposed to lead by chewing on toys manufactured outside North America. (Lead based paints may still be used in toy manufacture in some countries.) Other sources of lead include industrial processes(smelting and alloying of lead, manufacture of lead acid storage batteries, manufacture of certain polymers e.g. PVC).

Children are more sensitive to lead than adults; in children, lead is associated with developmental delays, impaired hearing, impaired growth and decreased IQ. Lead accumulates in bone marrow and impairs heme synthesis. Anemia can be present in both adults and children with chronic lead exposure. Conditions which result in bone remodelling, such as growth, osteoporosis and other pathologic changes to bone can release lead for redistribution to other tissues. Chronic abdominal complaints (cramping pain, nausea, poor appetite) may also attend higher levels of lead exposure. In adults, lead exposure has been associated with increased irritability, hostility, depression, interpersonal difficulties and difficulty concentrating as well as peripheral sensory and motor neuropathies. Lead may exacerbate the toxic effects of other elements including cadmium and mercury, and lead uptake from the diet may be exacerbated by deficiency in iron, calcium and zinc.

MERCURY VERY HIGH WITH PROVOCATION (PURPLE BAR)
Accepting the limitations of the reference ranges, if one hundred healthy, normal people are tested without provocation, approximately one of them would have a mercury result in the same range into which this patient's result falls (purple bar). In an unprovoked sample, this result would be considered very high. A provoked result in this range does not automatically mean that the body burden of mercury is correspondingly high.

The finding of a purple bar for mercury does not automatically guarantee that mercury is causing a problem for this patient, but it does call for a very careful review of the clinical picture, since mercury toxicity can manifest with a wide variety of symptoms, many of them nonspecific. Note that chronic exposure to mercury can result in kidney damage with decreased excretion of mercury in urine.

Note that a purple bar for mercury might also be seen if the creatinine is markedly low. The reported value is the raw result divided by the creatinine; a markedly low creatinine can artificially inflate the normalized result. In the absence of an artifact due to low creatinine, a result in the red or purple range for a toxic/potentially toxic element should, at a minimum, prompt a very thorough review of the clinical picture.

Individuals can be more or less sensitive to a given level of mercury depending on other factors such as the presence or absence of other toxic elements such as lead, cadmium and arsenic, nutritional status (e.g. antioxidant levels), exposure to other toxins/free radicals, and the overall health status of the individual.

Mercury has the potential to damage/affect any organ system, as it binds to the sulphur-containing portions of proteins found throughout the body. Suppression of the immune system and dysregulation of immunity may occur. General symptoms such as fatigue, headache and loss of appetite are also noted. Neurologic symptoms are prominent and can include numbness, tingling and eventual loss of sensation in the extremities. Alteration in taste (metallic taste), hearing and vision may be seen. Tremor and problems with balance and coordination are common with chronic exposure. Irritability and excitability may also manifest with chronic exposure. Advanced mercury intoxication can result in manic/psychotic behaviour.

Dietary sources of mercury include seafood (especially larger fish toward or at the top of the food chain, e.g. tuna and swordfish) and high fructose corn syrup (HFCS). A serving of larger, predatory fish can contain up to 10 micrograms of methymercury. Children and pregnant women should limit intake of, or avoid eating altogether, these larger fish. The levels of mercury found in HFCS-containing products are substantially lower than those found in seafood, but children consume large (and increasing) amounts of HCFS, and children are more sensitive to the effects of mercury than adults. Non-food sources of mercury include vaccines received prior to around 2002, allergy shots received from the 1960's through 1990's, silvery coloured dental amalgams and some laboratory equipment. Mercury is present in the emissions from coal-fired power plants, and residue from

previous use of mercury-based fungicides and pesticides may contaminate some cropland.

Elemental (metallic/liquid) mercury primarily causes health effects when it is breathed as a vapor where it can be absorbed through the lungs. These exposures can occur when elemental mercury is spilled or products that contain elemental mercury break and expose mercury to the air, particularly in warm or poorly-ventilated indoor spaces. Symptoms include: tremors, emotional changes (e.g., mood swings, irritability, excitability, nervousness, excessive shyness), insomnia, neuromuscular changes (such as weakness, muscle atrophy, twitching); headaches; sensorimotor disturbances, diminished performance on tests of cognitive function. At higher exposures there may be kidney effects, respiratory failure and death.

High exposures to soluble mercury salts (inorganic mercury) may result in damage to the gastrointestinal tract, the nervous system, and the kidneys. Symptoms of high exposure to inorganic mercury include: skin rashes and dermatitis, mood swings, memory loss, mental disturbances, and muscle weakness.

The primary health effect of methylmercury on fetuses, infants and children is impaired neurological development. Symptoms of methylmercury intoxication may include: impairment of peripheral vision, peripheral/periorbital sensory disturbances, incoordination, speech impairment, hearing impairment, ataxia; and muscle weakness.

THALLIUM HIGHER THAN AVERAGE WITH PROVOCATION (YELLOW BAR)
Accepting the limitations of the reference ranges, if one hundred healthy, normal people are tested without provocation, about twenty-seven of them would have a thallium result in the same range into which this patient's result falls (yellow bar). In an unprovoked sample, this result would be considered higher than average. A provoked result in this range does not automatically mean that the body burden of thallium is high. Thallium is excreted by both renal and fecal routes; urine is considered to be a good marker of inhalational and dietary exposure to thallium in unprovoked specimens.

Thallium occurs naturally in the ores of various heavy metals; raised levels in soil and water are found in the vicinity of smelters, mines, coal burning power plants, brick works and cement plants, due to particulate emission. In contaminated areas, raised levels are found in produce, meat and fish. In the past, it was used as rat poison, but this was discontinued in the 1970's. Thallium also finds usage in the semiconductor industry, and in the manufacture of other electronic devices, as well as in medical imaging. Since it is very well absorbed from the GI tract, thallium has also been used for homicidal purposes.

There are fairly good data regarding the urine level of thallium at which symptoms of early adverse effects might be expected. Assuming an average creatinine level, subtle adverse effects might be expected at around a normalized urine thallium level of 4 mcg/g creatinine, or at least ten times higher than the reference ranges cited by RMA. Thallium toxicity shares many features in common with thiamine deficiency, namely, interference with cellular energy production. Acute thallium exposure at toxic levels presents with nausea, vomiting and abdominal pain followed by neurologic symptoms (paresthesias, tender painful extremities, confusion, delirium, convulsions). Chronic low-level thallium exposure might result in sleep disorders, fatigue, muscle weakness, sensorimotor polyneuropathy (sensory first, followed by motor) and alopecia. Increased risk of suicide has been associated with thallium exposure.

TIN HIGH WITH PROVOCATION (RED BAR)
Accepting the limitations of the reference ranges, if one hundred healthy, normal people are tested without provocation, about four of them would have a tin result in the same range into which this patient's result falls (red bar). In an unprovoked sample, this result would be considered high.

Note that a red bar for tin might be seen if the creatinine is markedly low. The reported value is the raw result divided by the creatinine; a markedly low creatinine can artificially inflate the normalized result. In the absence of an artifact due to low creatinine, a red bar for tin should, at a minimum, prompt a thorough review of the clinical picture.

Tin exposure consists of inorganic and organic tim compounds. Most inorganic tin (such as tin leaching from food tins) is not absorbed well, but urine does reflect the small fraction that is absorbed after ingestion. (The remaining fraction is excreted in feces.) Depending on the structure, some organotin compounds may be excreted in urine (dimethyltin,trimethyltin). Tributyl tin is excreted in bile. Depending on exposure, urine tin may reflect exposure to toxic or relatively nontoxic forms of tin, but most often will represent absorbed inorganic tin from the diet. Many of the organotin compounds found in seafood, such as tributyltin, are not well represented in urine.

Soils are widely contaminated with tin, and tin is also naturally present in soil, so tin is present in food. The main sources of tin are canned foods, cereal grains, and toothpaste formulations for sensitive teeth. Leaching of tin from tin cans is much lower in cans that have a protective polymer coating on the inside surface, and in uncoated

tins, the levels in food are much higher. Acidic foods and beverages are more likely to leach tin from container walls. Seafood may be contaminated with tin due to bioaccumulation from use of organotin antifouling paint for boat hulls. Water passing through PVC pipes contains organotin as mentioned below. Some multivitamins e.g. Centrum do include a small amount of tin in the formulation and some authorities consider tin to be an essential nutrient in minute amounts.

Tin is used in a wide range of industrial settings: metal food containers, paint, alloys, glassmaking, ceramics, catalysis, electroplating, ink manufacture, as a stabilizer in PVC polymers. Organotin compounds are also used as disinfectants and fungicides used for treating wood.

Tin intoxication presents differently depending on the type of tin. Chronically inhaled low level tetrahydratin exposure manifests with fatigue, depression, headaches, insomnia, adrenal dysfunction, dyspnea and asthma. neurologic symptoms including poor co-ordination, balance problems, neuropathy as well as problems with vision and memory. Other nonspecific complaints such as fatigue, achiness, general malaise and depression can also be noted. Chronic inorganic tin exposure may also be associated with increased risk of heart disease. In general, however, there are no data to indicate any adverse effects in humans associated with chronic exposure to inorganic tin in levels which do not result in acute GI symptoms.

Organotin compounds interfere with heme synthesis and can produce anemia, kidney and hepatocyte damage. They may also stimulate catecholamine production, leading to fluctuating blood glucose and hypertension. In general, organotin compounds are potent neurotoxins because they are quite lipophilic. Acute exposure can lead to encephalopathy and cerebral edema, probably through uncoupling of oxidative phosphorylation. Acute exposure can also result in tremor, seizures, hallucinations and psychosis. Presumably, some or all of these could signs and symptoms might manifest with chronic, low level exposure as well, but this has not been extensively studied. Tributyltin (TBT) has been studied for its role in promoting obesity "TBT and its congeners are chemical stressors or obesogens that activate RXR:PPAR gamma signaling to promote long-term changes in adipocyte number and/or lipid homeostasis after developmental or chronic lifetime exposure". (Grün F et al. Endocrine-disrupting organotin compounds are potent inducers of adipogenesis in vertebrates. Mol Endocrinol 2006;20:2141-2155.) Organotin compounds are highly irritating to skin, and are absorbed through the skin.

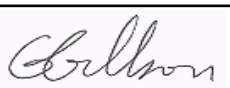
URANIUM HIGHER THAN AVERAGE POST-PROVOCATION (YELLOW BAR)
Accepting the limitations of the reference ranges, if one hundred healthy, normal people are tested without provocation, about twenty-seven of them would have a uranium result in the same range into which this patient's result falls (yellow bar). In an unprovoked sample, this result would be considered higher than average. A post-provocation uranium result with a yellow bar is probably not a major concern, if the clinical picture does not support uranium toxicity.

Uranium is found naturally in groundwater, air and soil, so human exposure is assured. It is unclear whether certain plant foods have a greater propensity to accumulate uranium than others; other factors such as the nature of the soil, pH and so forth probably have more influence than the type of plant. Shellfish have been reported to accumulate uranium (http://www.hc-sc.gc.ca/ewh-semt/pubs/water-eau/uranium/exposure-exposition-eng.php). Groundwater levels vary widely from place to place due to local geology (water flowing through granite and some sandstone rock formations tends to be higher in uranium).

The primary industrial exposure likely comes from mining and processing of uranium ore to produce fissionable material. An unrecognized, unregulated exposure mechanism is the production/utilization of phosphate fertilizers. Depleted uranium is used in ceramic glazes, glass tinting, armour-piercing munitions, and radiation shields.

Uranium toxicity is essentially chemical toxicity, according to the ATSDR. While enriched uranium may pose an increased cancer risk through radioactivity, this is not true for naturally-occurring uranium. Tissue damage may occur through oxidative stress mechanisms, as seems to be the case for the metallotoxicity seen with thorium. The kidney is most sensitive to uranium, but uranium is considered much less nephrotoxic than cadmium, lead and mercury, and renal damage appears to be reversible over time. Anemia in the face of elevated urine uranium might lead one to think about anemia of renal disease (Berradi H et al. Renal anemia induced by chronic ingestion of depleted uranium in rats. Toxicol Sci 2008;103:397-408.) Although uranium deposits quite readily in bone, there is little evidence of toxic effects on bone. Overall, uranium is considered to have a low order of chemical or metallotoxicity.

Urine levels in uranium mill workers, and in soldiers with embedded fragments of depleted uranium range upward from 4 micrograms/L to over 100 micrograms/L. Renal toxicity was not seen at the low end of this range. (In adult males micrograms/L and micrograms/g creatinine are roughly interchangeable.)



George Gillson, MD PhD
Medical Director

With the exception of toxicity investigations for selected elements, the College of Physicians and Surgeons of Alberta considers urine elemental analysis to be complementary medicine. Analysis of elements in urine as an indication of nutritional status has been used in research but is not yet approved by the College of Physicians and Surgeons. Rocky Mountain Analytical does not diagnose or make treatment recommendations as data is provided for research and educational purposes only.