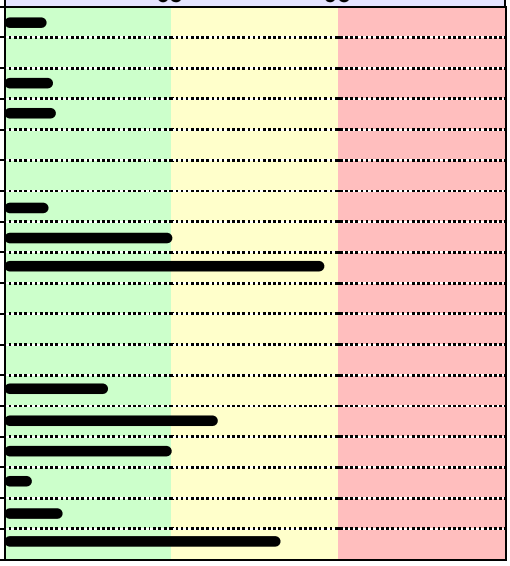
MOSAIC DIAGNOSTICS
Formerly Great Plains Laboratory

LAB#: H000000-0000-0
PATIENT: Sample Patient
SEX: Male
AGE: 77
CLIENT#:

Toxic & Essential Elements; Hair

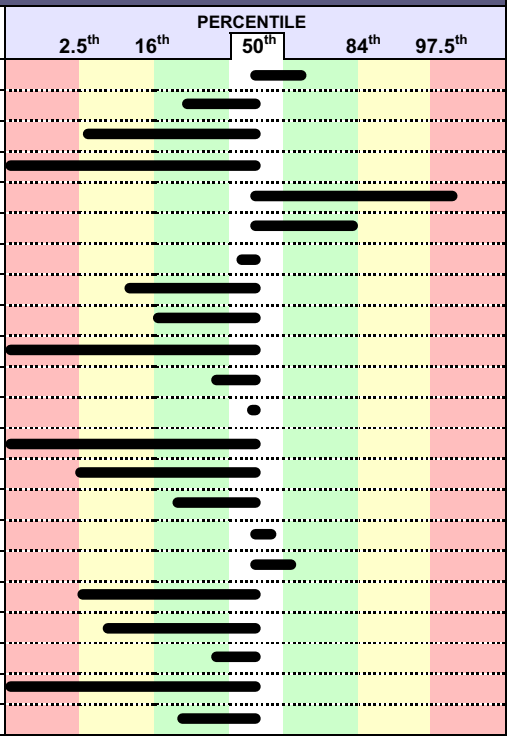
TOXIC METALS

		RESULT µg/g	REFERENCE INTERVAL
Aluminum	(Al)	1.5	< 7.0
Antimony	(Sb)	< 0.01	< 0.066
Arsenic	(As)	0.027	< 0.080
Barium	(Ba)	0.29	< 1.0
Beryllium	(Be)	< 0.01	< 0.020
Bismuth	(Bi)	< 0.002	< 2.0
Cadmium	(Cd)	0.021	< 0.065
Lead	(Pb)	0.82	< 0.80
Mercury	(Hg)	2.8	< 0.80
Platinum	(Pt)	< 0.003	< 0.005
Thallium	(Tl)	< 0.001	< 0.002
Thorium	(Th)	< 0.001	< 0.002
Uranium	(U)	0.036	< 0.060
Nickel	(Ni)	0.31	< 0.20
Silver	(Ag)	0.08	< 0.08
Tin	(Sn)	0.05	< 0.30
Titanium	(Ti)	0.21	< 0.60
Total Toxic Representation			



ESSENTIAL AND OTHER ELEMENTS

		RESULT µg/g	REFERENCE INTERVAL
Calcium	(Ca)	554	200- 750
Magnesium	(Mg)	31	25- 75
Sodium	(Na)	7	20- 180
Potassium	(K)	3	9- 80
Copper	(Cu)	64	11- 30
Zinc	(Zn)	200	130- 200
Manganese	(Mn)	0.14	0.08- 0.50
Chromium	(Cr)	0.37	0.40- 0.70
Vanadium	(V)	0.018	0.018- 0.065
Molybdenum	(Mo)	0.010	0.025- 0.060
Boron	(B)	0.82	0.40- 3.0
Iodine	(I)	0.54	0.25- 1.8
Lithium	(Li)	< 0.004	0.007- 0.020
Phosphorus	(P)	126	150- 220
Selenium	(Se)	0.75	0.70- 1.2
Strontium	(Sr)	1.4	0.30- 3.5
Sulfur	(S)	48100	44000- 50000
Cobalt	(Co)	0.003	0.004- 0.020
Iron	(Fe)	5.0	7.0- 16
Germanium	(Ge)	0.033	0.030- 0.040
Rubidium	(Rb)	< 0.003	0.011- 0.12
Zirconium	(Zr)	0.035	0.020- 0.44



SPECIMEN DATA

COMMENTS:

Date Collected: **05/16/2017**
Date Received: **05/23/2017**
Date Completed: **05/25/2017**
Methodology: **ICP/MS**

Sample Size: **0.199 g**
Sample Type: **Head**
Hair Color:
Treatment:
Shampoo:

RATIOS

ELEMENTS	RATIOS	RANGE
Ca/Mg	17.9	4- 30
Ca/P	4.4	0.8- 8
Na/K	2.33	0.5- 10
Zn/Cu	3.13	4- 20
Zn/Cd	> 999	> 800

HAIR ELEMENTS REPORT
INTRODUCTION

Hair is an excretory tissue for essential, nonessential and potentially toxic elements. In general, the amount of an element that is irreversibly incorporated into growing hair is proportional to the level of the element in other body tissues. Therefore, hair elements analysis provides an indirect screening test for physiological excess, deficiency or maldistribution of elements in the body. Clinical research indicates that hair levels of specific elements, particularly potentially toxic elements such as cadmium, mercury, lead and arsenic, are highly correlated with pathological disorders. For such elements, levels in hair may be more indicative of body stores than the levels in blood and urine.

All screening tests have limitations that must be taken into consideration. The correlation between hair element levels and physiological disorders is determined by numerous factors. Individual variability and compensatory mechanisms are major factors that affect the relationship between the distribution of elements in hair and symptoms and pathological conditions. It is also very important to keep in mind that scalp hair is vulnerable to external contamination of elements by exposure to hair treatments and products. Likewise, some hair treatments (e.g. permanent solutions, dyes, and bleach) can strip hair of endogenously acquired elements and result in false low values. Careful consideration of the limitations must be made in the interpretation of results of hair analysis. The data provided should be considered in conjunction with symptomology, diet analysis, occupation and lifestyle, physical examination and the results of other analytical laboratory tests.

Caution: The contents of this report are not intended to be diagnostic and the physician using this information is cautioned against treatment based solely on the results of this screening test. For example, copper supplementation based upon a result of low hair copper is contraindicated in patients afflicted with Wilson's Disease.

Lead High

This individual's hair Lead (Pb) level is considered to be moderately elevated. Generally, hair is a good indicator of exposure to Pb. However, elevated levels of Pb in head hair can be an artifact of hair darkening agents, or dyes, e.g. lead acetate. Although these agents can cause exogenous contamination some transdermal absorption does occur.

Pb has neurotoxic and nephrotoxic effects in humans as well as interfering with heme biosynthesis. Pb may also affect the body's ability to utilize the essential elements calcium, magnesium, and zinc. At moderate levels of body burden, Pb may have adverse effects on memory, cognitive function, nerve conduction, and metabolism of vitamin D. Children with hair Pb levels greater than 1 µg/g have been reported to have a higher incidence of hyperactivity than those with less than 1 µg/g. Children with hair Pb levels above 3 µg/g have been reported to have more learning problems than those with less than 3 µg/g. Detoxification therapy by means of chelation results in transient increases in hair lead. Eventually, the hair Pb level will normalize after detoxification is complete.

Symptoms associated with excess Pb are somewhat nonspecific, but include: anemia, headaches, fatigue, weight loss, cognitive dysfunction and decreased coordination.

Sources of exposure to Pb include: welding, old leaded paint (chips/dust), drinking water, some

fertilizers, industrial pollution, lead-glazed pottery, Ayruvedic herbs and use of firemarms.
Tests for Pb body burden are: urine elements analysis following provocation with intravenous Ca-EDTA, or oral DMSA. Whole blood analysis for Pb reflects recent or ongoing exposures and does not correlate well with total body burden.

Mercury High

Hair mercury (Hg) is an excellent indiator of exposure to methylmercury from fish. Mercury is toxic to humans and animals. Individuals vary greatly in sensitivity and tolerance to Hg burden.

Hg can suppress biological selenium function and may cause or contribute to immune dysregulation in sensitive individuals. Hallmark symptoms of excess Hg include: loss of appetite, decreased senses of touch, hearing, and vision, fatigue, depression, emotional instability, peripheral numbness and tremors, poor memory and cognitive dysfunction, and neuromuscular disorders. Hair Hg has been reported to correlate with acute myocardial infarction and on average each 1 µg/g of hair Hg was found to correlate with a 9% increase in AMI risk (Circulation 1995; 91:645-655).

Sources of Hg include dental amalgams, fish, water supplies, some hemorrhoidal preparations, skin lightening agents, instruments (thermometers, electrodes, batteries), and combustion of fossil fuels, Ayurvedic herbs, some fertilizers, and the paper/pulp and gold industries. After dental amalgams are installed or removed a transient (several months) increase in hair Hg is observed. Also, ”baseline” hair Hg levels for individuals with dental amalgams are higher (about 1 to 2 µg/g) than are baseline levels for those without (below 1 µg/g).

Confirmatory tests for elevated Hg are measurement of whole blood as an indication of recent/ongoing exposure (does not correlate with whole body accumulation) and measurement of urine Hg before and after administration of a dithiol metal binding agent such as DMSA or DMPS (an indication of total body burden).

Nickel High

Hair is a reasonable tissue for monitoring exposure to Nickel (Ni). However, hair is commonly contaminated with Ni from hair treatments and dyes. When hair Ni is measured at more than .6 ppm, the possible use of hair dyes or colorings should be investigated before concluding that excessive Ni is present.

There is substantial evidence that Ni is an essential element which is required in extremely low amounts. However, excess Ni has been well established to be nephrotoxic, and carcinogenic. Elevated Ni is often found in individuals who work in the electronic and plating, mining, and steel manufacture industries. A cigarette typically contains from 2 to 6 mcg of Ni; Ni is absorbed more efficiently in the lungs than in the gastrointestinal tract. Symptoms of chronic Ni exposure include dermatitis, chronic rhinitis, and hypersensitivity reactions. Ni can hypersensitize the immune system, subsequently causing hyperallergenic responses to many different substances.

Symptoms of Ni toxicity are dermatitis and pulmonary inflammation (following exposure to Ni dust, smoke). Long term or chronic Ni toxicity may lead to liver necrosis and carcinoma.

A test for elevated Ni body burdenis the measurement of urine Ni before and after administration of chelating agents that mobilize Ni i.e., Ca-EDTA.

Sodium Low

The level of Sodium (Na) in hair has not been documented to be indicative of dietary adequacy or nutritional status. Na is an essential element with extracellular electrolyte functions, but these functions do not occur in hair. Low hair Na may have no clinical significance or it may be consistent with electrolyte imbalance associated with adrenal insufficiency. In this condition, blood Na would be low, blood potassium would be high, and urinary levels of Na would be expected to be high. Observations at DDI indicate that Na and potassium levels in hair are commonly low in association with emotional stress. The low levels of Na and potassium are frequently concomitant with high levels of calcium and magnesium in hair. This apparent "emotional stress pattern" requires further investigation.

Appropriate tests for Na status as an electrolyte are measurements of Na in whole blood and urine, and measurements of adrenocortical function.

Potassium Low

The level of Potassium (K) in hair does not reflect nutritional status or dietary intake. However, hair K levels may provide clinically relevant information pertaining to adrenal function and/or electrolyte balance.

K is an electrolyte and a potentiator of enzyme functions in cells, but neither of theses functions takes place in hair. K can be low in the body as the result of gastrointestinal or renal dysfunction, or as a side effect of some diuretics. In adrenocortical hyperactivity, blood levels of K are depressed, while urinary K is increased. Low hair K should be viewed as a screening test. Observations at DDI indicate that hair levels of sodium and K are commonly low in association with emotional stress. The low levels of sodium and K are frequently concomitant with high levels of calcium and magnesium in hair. This apparent "emotional stress pattern" requires further investigation.

Symptoms of true K deficiency include: muscle weakness, fatigue, and tachycardia. Diabetic acidosis can result in severe K loss.

Confirmatory tests for K deficiency include measurements of packed red blood cell K; whole blood K and the sodium/K ratio; urine K and the sodium/K ratio. An electrocardiogram may show abnormalities when K is low in serum/plasma or whole blood.

Copper High

The high level of Copper (Cu) in hair may be indicative of excess Cu in the body. However, it is important first to rule out exogenous contamination sources: permanent solutions, dyes, bleaches, swimming pool/hot tub water, and washing hair in acidic water carried through Cu pipes. In the case of contamination from hair preparations, other elements (aluminum, silver, nickel, titanium) are usually also elevated.

Sources of excessive Cu include contaminated food or drinking water, excessive Cu supplementation, and occupational or environmental exposures. Insufficient intake of competitively absorbed elements such as zinc or molybdenum can lead to, or worsen Cu excess.

Medical conditions that may be associated with excess Cu include: biliary obstruction (reduced ability to excrete Cu), liver disease (hepatitis or cirrhosis), and renal dysfunction. Symptoms associated with excess Cu accumulation are muscle and joint pain, depression, irritability, tremor, hemolytic anemia, learning disabilities, and behavioral disorders.

Confirmatory tests for Cu excess are a comparison of Cu in pre vs. post provocation (D-penicillamine, DMPS) urine elements tests and a whole blood elements analysis.

Chromium Low

Hair Chromium (Cr) is a good indicator of tissue levels and may provide a better indication of status than do urine or blood plasma/serum (Nielsen, F.H. In Modern Nutrition on Health and Disease; 8th Edition, 1994. Ed. Shils, Olson and Shike. Lea and Febiger, Philadelphia). Hair Cr is seldom affected by permanent solutions, dyes and bleaches.

Cr (trivalent) is generally accepted as an essential trace element that is required for maintenance of normal glucose and cholesterol levels; it potentiates insulin function, i.e., as a part of ”glucose tolerance factor”. Deficiency conditions may include hyperglycemia, transient hyper/hypoglycemia, fatigue, accelerated atherosclerogenesis, elevated LDL cholesterol, increased need for insulin and diabetes-like symptoms, and impaired stress responses. Marginal or insufficient Cr is common in the U.S., where average tissue levels are low compared to those found in many other countries. Low hair Cr appears to be associated with increased risk of cardiovascular disease and an atherogenic lipoprotein profile (low HDL, high LDL). Common causes of deficiency are ingestion of highly processed foods, inadequate soil levels of Cr, gastrointestinal dysfunction, and insufficient vitamin B-6. Cr status is also compromised in patients with iron overload/high transferrin saturation because transferrin is a major transport protein for Cr.

Confirmatory tests for Cr adequacy include glucose tolerance and packed red blood cell elements analysis.

Molybdenum Low

Low Molybdenum (Mo) in hair is a possible indication of Mo deficiency. Hair is very rarely contaminated with exogenous Mo.

Mo is an essential trace element that is an activator of specific enzymes such as: xanthine oxidase (catalyzes formation of uric acid), sulfite oxidase (catalyzes oxidation of sulfite to sulfate), and aldehyde dehydrogenase (catalyzes oxidation of aldehydes). Possible effects or symptoms consistent with Mo deficiency are: subnormal uric acid in blood and urine, sensitivity or reactivity to sulfites, protein intolerance (specifically to sulfur-bearing amino acids), and sensitivity or reactivity to aldehydes.

True Mo deficiency is uncommon but may result from: a poor-quality diet, gastrointestinal dysfunctions, or tungsten exposure. Tungsten (from ”TIG” welding) can be a powerful antagonist of Mo retention in the body. Copper overload can also reduce Mo retention.

Because normal blood and blood cell Mo levels are very low (a few parts per billion), blood measurement is not an appropriate tissue for confirmation of subnormal molybdenum.

Confirmatory tests for Mo deficiency include measurement of urine sulfite concentration (increased in Mo deficiency), measurement of blood/urine uric acid level (decreased in Mo deficiency), and measurement of urinary Mo content.

Lithium Low

Lithium (Li) is normally found in hair at very low levels. Hair Li correlates with high dosage of Li carbonate in patients treated for Affective Disorders. However, the clinical significance of low hair Li levels is not certain at this time. Thus, hair Li is measured primarily for research purposes. Anecdotally, clinical feedback to DDI consultants suggests that low level Li supplementation may have some beneficial effects in patients with behavioral/emotional disorders. Li occurs almost universally in water and in the diet; excess Li is rapidly excreted in urine.

Li at low levels may have essential functions in humans. Intracellularly, Li inhibits the conversion of phosphorylated inositol to free inositol. In the nervous system this moderates neuronal excitability. Li also influences monamine neurotransmitter concentrations at the synapse (this function is increased when Li is used therapeutically for mania or bipolar illness).

A confirmatory test for low Li is measurement of Li in blood serum/plasma.

Phosphorus Low

Hair Phosphorus (P) levels do not accurately reflect the adequacy of the biochemical functions of P. Further, hair P concentration does not correlate with dietary intake of P. However, hair P levels may be affected by abnormal calcium, P or vitamin D metabolism and possibly by abnormal magnesium levels. Hair P levels are measured primarily for research purposes.

P is a major component of mineralized tissue such as bone and teeth. Along with calcium, P assimilation into bone is regulated by vitamin D. Phosphates also are present in every cell of the body where they are involved in chemical energy transfer and enzyme regulation. Phosphorylation chemistry is part of carbohydrate, amino acid, and lipid metabolism.

Appropriate tests for assessing P status are measurements of whole blood (total) P level; serum vitamin D-3 and/or 25-OH vitamin D-3 level; and 24-hour urinary P level (together with measurements of calcium and magnesium).

Rubidium Low

Hair Rubidium (Rb) levels may correlate with exposure and with Rb levels in other tissues. Rubidium is not considered to have a biological function; due to itÆs chemical similarity to potassium, it may be taken up by plants and animals (Comp. Biochem.Physiol.; 73: 223, 1982, Haemotologica 75: 27, 1990). Daily intake varies from 1-5 mg depending on geography and diet.

The Hair Toxic and Essential Elements test is a screen for element exposures over the last 3-4 months.

Total Toxic Element Indication

The potentially toxic elements vary considerably with respect to their relative toxicities. The accumulation of more than one of the most toxic elements may have synergistic adverse effects, even if the level of each individual element is not strikingly high. Therefore, we present a total toxic element ”score” which is estimated using a weighted average based upon relative toxicity. For example, the combined presence of lead and mercury will give a higher total score than that of the combination of silver and beryllium.